PB84-103779

Household Hazardous Waste Disposal Project Metro Toxicant Program Report Number ID SLEUTH (Strategies and Lessons to Eliminate Unused Toxicants: Help) - Educational

Municipality of Metropolitan Seattle-METRO,WA

Prepared for

Environmental Protection Agency
Seattle, WA

Aug 83

U.S. Department of Commerce
National Technical Information Service
NTIS

PB84-103779

SLEUTH

Educational Activities on the Disposal of Household Hazardous Waste

Household Hazardous Waste Disposal Project

METRO

Metro Toxicant Program
Report No.1D

Water Quality Division
August 1982

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

Municipality of Metropolitan Seattle

50272-101

REPORT DOCUMENTATION PAGE

1. REPORT NO. MMS/WQR - 8214

2.

3. Recipient's Accession No PB84 103779

4. Title and Subtitle
SLEUTH
Educational Activities on the Disposal of Household Hazardous Waste
Household Hazardous Waste Disposal Project; Metro Toxicant Program Report No. 1D

5. Report Date Date of Issue: August 1983

6.

7. Author(s)
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8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Municipality of Metropolitan Seattle (METRO)
Water Quality Division, Toxicant Control Planning Section
821 Second Avenue, Seattle, WA 98104

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G) #P-000233-01

12. Sponsoring Organization Name and Address
U.S. Environmental Protection Agency-Region 10
Washington State Operations Office
Lacey, WA 90503

13. Type of Report & Period Covered
Final; 1981-1982

14.

15. Supplementary Notes

Prepared in cooperation with the Office of Environmental Education-Northwest Section, Superintendent of Public Instruction.

16. Abstract (Limit: 200 words)

This report presents a number of educational activities for students in the elementary and secondary grades that will help them understand the issues related to, and the best disposal options for hazardous household wastes. Teachers are provided with a series of illustrated lessons and quizzes, problem solving exercises, and role playing games. The projects are designed to define terms and concepts for understanding hazardous wastes, provide information on disposal systems available in King County, indicate problems with current disposal practices, and discuss personal responsibility for proper waste disposal.

17. Document Analysis a. Descriptors

Household goods; Hazardous materials; Waste disposal; Education; Training devices; Management games; child guidance.

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement:
Release Unlimited

19. Security Class (This Report) Unclassified

20. Security Class (This Page) Unclassified

21. No. of Pages 179

22. Price

(See ANSI-Z39.18)

See Instructions on Reverse

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

August, 1982

sleuth*

[* **S**trategies and
lessons to
eliminate
unused
toxicants:
help!]

--EDUCATIONAL ACTIVITIES ON THE DISPOSAL OF HOUSEHOLD HAZARDOUS WASTE--

REPORT D
OF THE
HOUSEHOLD HAZARDOUS WASTE DISPOSAL PROJECT
METRO TOXICANT PROGRAM #1

by
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in cooperation with
Office of Environmental Education
-Northwest Section
Superintendent of Public Instruction

EPA Grant No. P-000233-01
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Olympia, Washington 98504

DISCLAIMER

Although the research or investigation described herein has been funded in part by the U.S. Environmental Protection Agency through grant No. P-000233-01 to the Municipality of Metropolitan Seattle (Metro), it has not been subjected to the Agency's peer and administrative review and therefore does not necessarily reflect the views of the Agency, and no official endorsement should be inferred.

HOUSEHOLD HAZARDOUS WASTE DISPOSAL
REPORT D: SLEUTH -- EDUCATIONAL ACTIVITIES

FOREWORD AND ACKNOWLEDGEMENTS

HOUSEHOLD HAZARDOUS WASTE -- WHAT's IT ALL ABOUT? To most people, hazardous wastes are found only in Love Canal, in large industrial dumps or in streams of toxic chemicals flowing from factory outfalls. But hazardous waste is really any substance that, when disposed of, poses a risk (e.g., ignitable, toxic) to people or to the environment.

A wide range of household products fits such a definition: pesticides, automotive oil, solvents, household cleaners, antifreeze, and others. Some of the chemicals found in these products are known or suspected mutagens, carcinogens or teratogens. Often they are toxic to human beings, fish and wildlife in small amounts. Every day, literally tons of these chemicals are washed down drains or dumped in the trash. Because they come from many small, diverse sources (households) rather than a few large, localized sources (industries), they are difficult to control and are not currently regulated.

In addition, sales of a number of household toxic substances -- including certain pesticides and vinyl chloride-containing products -- have been banned or severely restricted. Quantities of these banned products can still be found in people's homes. The average consumer has had no choice, until now, but to dispose of these toxic products in ways allowing their eventual release into the environment.

WHY IS METRO CONCERNED ABOUT HOUSEHOLD HAZARDOUS WASTE? As the regional agency responsible for water quality and sewage treatment--as well as transit--in King County, Metro is interested in keeping the region's waters clean. Metro has initiated a Toxicant Pretreatment Planning Study, a Toxicant Inventory Study and other related projects as part of its commitment to assess the presence, sources, fates and effects of toxic substances in the local waters. The studies will help Metro identify problems and formulate effective control programs for point and nonpoint sources of problem toxicants.

HOUSEHOLDS CONTRIBUTE SIGNIFICANTLY to wastewater flows to the sewage treatments plants and solid waste to landfills. House, garden and garage products, such as paints, preservatives, pesticides, antifreeze and oil, can contaminate local stormwater runoff and streams. While not large when compared to industrial contributions, household hazardous wastes can be a source of problem toxicants in local waters.

BECAUSE OF THESE CONCERNS, METRO HAS BEEN STUDYING this issue and its implications as part of its Toxicant Control Program. In 1981, Metro received a water quality management grant from the U.S. Environmental Protection Agency to develop a disposal plan for small quantities of household toxicants. The Household Hazardous Waste Disposal (HHWD) Project was established as an interagency effort, coordinated by Metro and based on a working committee representing governmental agencies, private businesses, environmental and public interest groups, and concerned citizens. The goal of the project was to reduce the level of toxicants entering the environment by providing a solution to the problem of unsafe or improper disposal of household hazardous wastes.

THIS TEACHING UNIT IS ONE PART of the final report of the Household Hazardous Waste Disposal Project, which includes the following components (separately bound):

A. Summary,
B. Toxicants in Consumer Products,
C. Public Opinions and Actions,
D. SLEUTH - Educational Activities,
E. Directory.

The SLEUTH teaching unit is a major part of the project's final plan because education is the primary way to implement the project's recommendations. Unless people care about how they dispose of their hazardous wastes and take personal responsibility for their actions, nothing will change. Informed students become informed citizens.

CLAIRE DYCKMAN, LOLLY SMITH-GREATHOUSE AND CHRIS LUBOFF developed this teaching unit in a very short period of time and with an effort far exceeding their contractual agreement. Tony Angell and the Washington State Office of Environmental Education offered support, resource materials and critical input. Illustrations and graphics were provided by Jane Howard, Laura Davis, and Jim Callahan.

The following Seattle-area teachers reviewed the draft copy and gave us many constructive comments from the user's perspective: LaVon Bucher, Eva Testerman, Greg Coy, Paul Witt, and Pat Dyckman. Elaine Chapman, School Information Specialist for Metro, also provided very timely and useful review comments. Joe Simmler, Supervisor of the Toxicant Program at Metro, gave us technical and policy review as well as strong support for this teaching unit development.

WE THINK YOU WILL FIND this collection of classroom activities as exciting and informative as we have. If you would like more information on the subject of toxic substances and hazardous wastes, access to the other reports or information of related activities, please contact Metro at (206)-447-5885. Your comments are welcome.

Happy SLEUTH-ing!

David V. Galvin,
Project Manager, Metro

Susan Ridgley,
Project Coordinator,
Environmental Intern
Program/NW

TABLE OF CONTENTS

Foreword and Acknowledgements i

Table of Contents iv

Teachers Guide vii

INTRODUCTION 1

Introductory Quiz 5

Overhead Material: What's in Your House? 9

Overhead Material: Can Some of Your Household Products Harm You?. 10

SECTION I: MASTER SLEUTH 11

Directions 12

Sleuth Problems 13

Master Sleuth Charts 14

Missing Evidence 17

What Do You Do When Evidence is Missing? 18

Evidence:

What Do You Have? 22

The Label Must Tell You 23

Overhead Material: How Will You Dispose of It?. .24

Is is Legal? 25

Garbage Dumps and Landfills 27

Map: Garbage Dumps and Landfills 28

Sewerage System 29

Map: Sewerage Systems (Metro) 30

Overhead Material: The Sanitary Sewer. 31

Septic Tanks and Drainfields 32

Waterways 33

Map: Watershed Boundaries, Streams and Rivers .. 35

Overhead Material: Chemicals in the Water Cycle .36

Physical Characteristics 37

Landfills Leachate 38

Wastewater (Sewage) Treatment 39

Sludge 43

Movement of Chemicals in Soil and Water. 45

Routes to the Environment I 46

Routes to the Environment II 47

Persistence and Degradation 48

TABLE OF CONTENTS (continued)

Persistence and Accumulation 49
How Do Toxicants Get Inside Plants & Animals? . . 50
Overhead Material: How is it Absorbed, Distributed and Eliminated? 51
Could It Cause Immediate or Long-Term Harm? . . . 55
Bioaccumulation and Bioconcentration 52
Overhead Material: Bioconcentration 54
What is a Toxic Substance? 55
Measuring Acute Toxicity 56
Calculating Acute Toxicity 57
Figuring Out Chronic Toxicity 59
Sleuth Conclusion .60
Disposal Options/Tradeoffs: Automotive 61
Disposal Options/Tradeoffs: Pesticides. 62
Pesticide Disposal: Health Department. 63
Disposal Options/Tradeoffs: Household Cleaners. . . . 64
Disposal Options/Tradeoffs: Paints and Solvents. . . .65
Chart: Who is Responsible? 66

SECTION II: PROBLEM SOLVING AND ROLE PLAY. 67
Problem-Solving Exercises: Directions 68
Problem-Solving Exercises: Decision Sheet. 69
Problem-Solving Exercises: Scenario #1. 70
Scenario #2. 71
Scenario #3. 72
Role Play: Directions 73
Role Play Fact Sheet: Antifreeze and Systox 75
Role Play Committee 76
Game: DISPOSAL! 88

SECTION III: THE BIG PICTURE 99
Hazardous Trivia 100
Hazardous Issues 108
Worksheet: Hazardous Issues 113

TABLE OF CONTENTS (continued)

What Do You Do When You Don't Know 114
Hazardous Regulations: Laws 116
Worksheet: Unraveling Red Tape 121

SECTION IV: SUPPLEMENTAL ACTIVITIES AND REFERENCES. 125
Nursery Rhymes 126
Worksheet: Reading Labels--Household Cleaners. 128
Activity: Household Inventory 130
Worksheet: New Chemical Substances. 133
Worksheet: Substantial Risk 134
Activity: What is Evaporation? 135
Activity: Solubility in Water 137
Product Tables: Household Cleaners 139
Product Tables: Automotive Products 141
Product Tables: Paint Products 143
Product Tables: Pesticides 145
Typical Usages of Some Organic Priority Pollutant Compounds 148

Key to Game: Disposal!

    General Notes 149
    Disposal card information 153
    Card number notes .154
Extended Activities 159

Strategies and lessons to eliminate Unused toxicants. help!

A Teaching Unit on the Disposal of Household Hazardous Waste

Household hazardous wastes are an issue of personal responsibility. We and the environment we live in will be protected from hazardous substances only if students and their families:

- know which substances are harmful and which are benign;
- change some of their household practices to use substances which are least harmful;
- know how to use the safest disposal means available for harmful substances;
- choose to urge legislators and industry to improve the current use and disposal of harmful substances;
- choose to pay for safer practices and products either through taxes or higher product prices; and
- are able to make informed decisions.

These classroom activities have been designed to help the student (and teachers and parents!) understand these issues and discover the best disposal means for household products.

Household hazardous waste is a technical subject. These activities do not try to present everything there is to know about household hazardous waste, instead the materials illustrate disposal problems and emphasize ways to investigate when we don't have all the answers.

The issues of toxic substance control and hazardous waste disposal are relevent to each of us who use consumer products and dispose of household wastes. If we can begin to take personal responsibility for our actions and their consequences--if we can forsake the "out-of-sight-out-of-mind", "it's somebody else's problem" mentality -- we will have achieved a great deal. This package is a resource of activities designed to get you and your students thinking about these issues.

Table 1 on the following page provides you with a quick overview of the contents and an outline of this teaching unit. Pages xi through xv provide suggested options for one lesson or a series of lessons using the Sleuth activities and resources.

Experiment. Innovate. Create. Don't let the technical topics get in the way of the general concepts, problem-solving exercises and values clarification. Be a Sleuth and encourage your students to be Sleuths too.

Table 1:

DESCRIPTION OF CONTENTS BY SECTION

	INTRODUCTION
Definition *Research*	● Defines terms and concepts for understanding household hazardous wastes. ● Outlines scope of subject through a "quiz". Grades 4-12, 10 minutes to one day of lesson activities.
SECTION I.	MASTER SLEUTH
Reading *Writing* *Hypothesizing* *Problem Solving* *Map Reading* *Research* *Computation*	● Defines terms and concepts for understanding household hazardous wastes. ● Provides information on disposal systems available in King County. ● Indicates potential problems of current disposal practices. ● Discusses personal responsibility for the disposal of wastes. ● Indicates areas which will require further research and action on both the local and national level. Grades 4-6, one to three days of lesson activities. Grades 7-12, one to five days of lesson activities.
SECTION II.	PROBLEM SOLVING EXERCISES
Listening *Speaking* *Discussion* *Debate* *Problem Solving* *Group Discussion* *Role Play* *Research*	● Introduces tradeoffs of various disposal options. ● Discusses personal responsibility for the disposal of wastes. ● Indicates areas which will require further research and problem solving on both a local and a national level. Grades 4-6, one to three days of lesson activities. Grades 7-12, one to five days of lesson activities.
SECTION III.	THE BIG PICTURE
Values Clarification *Debate* *Discussion* *Analysis* *Vocabulary for Laws, Regulations.*	● Presents national issues of hazardous wastes disposal in larger than household quantities. ● Reviews laws, regulations and government responsibility. Grades 4-6, one day of lesson activities. Grades 7-12, one to four days of lesson activities.
SECTION IV.	SUPPLEMENTAL ACTIVITIES AND REFERENCES.
	● Worksheets for more detailed instruction. ● References for Sleuth and other activities.

TEACHING SUGGESTIONS

A. Grades 4-12--Short (One-Day) General Options

- **Option 1:** "Short-and-Sweet Overview"

  Read "What are Hazardous Wastes?" (p. 1,2)
  Outline subject using overhead materials:
    What's In Your House? (p. 22)
    Available Disposal Means (p. 24)
    The Sanitary Sewer (p. 29)
    Map of Sewage Systems (p. 30)
    Map of Garbage Dumps and Landfills (p. 28)
    Chemicals in the Water Cycle (p. 35)
    Map of Watershed Boundaries, Streams and Rivers (p. 36)
    Routes to the Environment I (p. 46)
    Routes to the Environment II (p. 47)
    How are Toxicants Absorbed, Distributed, Eliminated (p. 51)
    Bioconcentration (p. 54)
    Who's Responsible? (p. 66)
  Conclude with discussion of Disposal Options and Tradeoffs (p. 64, 65) for one kind of household product

- **Option 2:** "Quick Problem-Solving Exercise"

  Choose one of the four Sleuth problems (p.13)
  Do Master Sleuth (begin p. 11) as a class activity, without significant research
  Conclude with discussion of Disposal Options/ Tradeoffs (p. 64, 65) for your product

- **Option 3:** "Technical Introduction"

  Read "What Are Hazardous Wastes?" (p. 1,2)
  Read "What is a Chemical?" (p. 3,4)
  Outline subject using overhead materials:
    What's In Your House? (p. 22)
    Available Disposal Means (p. 24)
    Means to the Environment I, II (p. 46, 47)
  Define persistence, bioaccumulation, bioconcentration (see p. 48-54)
  Define acute and chronic toxicity (p. 53)
  Conclude with discussion of hazardous trivia (p. 100)

TEACHING SUGGESTIONS

B. Grades 4-6 -- General Two-to-Five-Day Options

- Option 1: "The Thorough Problem-Solving Exercise"

  Do four Sleuth problems (p. 13) as a class, one each day.
  Conclude with Disposal game (p. 89)
  (This will instruct students in map reading each day and repeat concepts)

- Option 2: "The A-Little-Bit-of-Everything Review"

  Day 1 Read and discuss Nursery Rhymes (p. 126)
  Use overhead materials to discuss ideas in rhymes:
  Chemicals in the Water Cycle (p. 35)
  The Sanitary Sewer (p. 29)
  Bioconcentration (p. 54)

  Day 2 Do Master Sleuth (p. 11) with one of four Sleuth problems (p. 13) as a class. (Skip materials you think are too difficult.)

  Day 3 Do one or two of the Problem-Solving Exercises (p. 67-72)

  Day 4 Play Disposal game (p. 89)

  Day 5 Discuss appropriate parts of one of the sheets on Disposal Options/Tradeoffs (p. 61, 62)
  Discuss one or two Hazardous Trivia (p. 100) and/or Hazardous Issues (p. 108) statements
  Conclude with discussion of What Do You Do When You Don't Know worksheet (p. 114)

TEACHING SUGGESTIONS

C. Grades 7-12 -- Home Economics or Consumer Education -- Two-to-Five Day-Options

- Option 1: "The Consumer Awareness Review"

Day 1	Do Introductory Quiz (p. 5) Do Hazardous Trivia (p. 100) Assign Household Inventory (p. 22)
Day 2	Review results of Household Inventory Use intordurctory materials on What are Hazardous Wastes (p. 1,2) What's In Your House? (p. 9) Do worksheet on What Does the Label Tell You? (p. 23)
Day 3	Do one or two Sleuth problems as a class (p. 13)
Day 4	Do two or three Problem-Solving Exercises (p. 68-72) in groups. Discuss in groups--Disposal Options/Tradeoffs for Household cleaners (p. 64)
Day 5	Discuss a few statements from Hazardous Trivia (p. 100) and Hazardous Issues (p. 108) Conclude with Introductory Quiz (p. 5)

- Option 2: "The Consumer as Problem-Solver Exercise"

Day 1	Read What are Hazardous Wastes (p. 1,2)
Day 2	Divide students into groups to do a Sleuth problem (p. 13) for one or two products
Day 3	Discuss results. Ask groups to do one of each Disposal Option/Tradeoffs (p. 64, 65) and present results to class
Day 4	Give problem-solving exercises or Role Play to each group (p. 68-88) Conclude with review of Who's Responsible? (p. 66)
Day 5	Conclude with Can Some of Your Household Products Harm You? (p. 10), Could It Cause Immediate or Long-Term Harm (p. 55) and overhead materials on Chemicals in the Water Cycle (p. 35) and Bioconcentration (p. 54) and statements from Hazardous Issues (p. 108).

TEACHING SUGGESTIONS

D. Grades 7-12 -- Social Studies or Contemporary Problems -- Two-to-Five-Day Options

- Option 1: "What-Do-We-Do-Now Discussion"

Day 1	Do Hazardous Trivia (p. 100) and What are Hazardous Wastes? (p. 1,2)
Day 2	Do one Sleuth problem as a class (p. 13)
Day 3	Review all worksheets on Disposal Options/ Trade-offs (p. 64, 65) Do one Problem-Solving Exercise (p. 68-72)
Day 4	Discuss as many Hazardous Issues (p. 108) as is appropriate Conclude with What Do You Do When You Don't Know exercises (p. 114)
Day 5	Do Role Play (p. 73), Who's Responsible (p. 66) and Red Tape (p. 121)

- Option 2: "Whose-Problem-Is-It-Anyway Discussion"

Day 1	Do one Sleuth problem as a class (p. 13) Review the other waste disposal systems (p. 27-36)
Day 2	Use Who's Resonsible (p. 66), Laws (p. 116) and Unravelling Red Tape (p. 121) to discuss management of hazardous wastes and government regulation in general
Day 3	Go through the entire sheet on Missing Evidence (p. 12) before using worksheet on What Do You Do When Evidence is Missing? (p. 20)
Day 4	Do Problem-Solving exercises or Role Play (p. 68-89)
Day 5	Discuss Hazardous Trivia (p. 100) and Hazardous Issues (p. 108)

E. Grades 7-12 -- Chemistry, Ecology or Biology -- Two-to-Five-Day Option

- Option: "Toxic and Hazardous Chemical Review"

Day 1	Introduce or conclude the unit with Hazardous Trivia (p. 100,) Hazardous Issues (p. 108),Nursery Rhymes (p. 126), or What Do You Do When You Don't Know (p. 114)
Day 2,3, or 4	Have students do three or four Sleuth problems (p. 13) for different kinds of products; emphasize chemical and biological issues (p. 36,37, 45-59) Go over the Product Tables (p. 139-145) carefully to highlight the information pertaining to your curriculum - chemical or biological Discuss the points outlined in Missing Evidence (p. 17) Assign the Household Inventory (p. 130) and the Introductory Quiz (p. 5) as extra projects. Do worksheets on Evaporation (p. 135) and Solubility (p. 137).

introduction

WHAT ARE HAZARDOUS WASTES?

These first pages are intended to define the basic terms and concepts that we will be dealing with: specifically HAZARDOUS WASTE, TOXIC SUBSTANCES and CHEMICALS.

WASTE is anything that somebody wants to get rid of. Don't forget, though, that something you don't want could be useful to someone else.

HAZARDOUS means dangerous. A hazardous substance is one which is likely to cause harm to the environment or to human health because of a relatively high degree of risk because of toxicity, corrosiveness, flammability, or reactivity.

HOUSEHOLD WASTE is waste from households......from products used in homes, gardens and automobiles.

So HOUSEHOLD HAZARDOUS WASTES are hazardous substances that households want to get rid of.

TOXIC means poisonous. A poison is something that causes illness, injury or death to any living organism.

TOXICITY means the degree to which a substance is poisonous. So every substance has some level of toxicity. Obviously many foods, such as oranges, are virtually non-toxic -- they have, for all intents and purposes, zero toxicity. Other substances are so poisonous that a single taste can be deadly -- *Botulinus* toxin is one example. There are a whole range of toxins in between, such as alcohol, aspirins, poison ivy and drain cleaners.

It is important to realize that there are two kinds of toxicity: ACUTE toxicity and CHRONIC toxicity. (More about this difference on P. 54)

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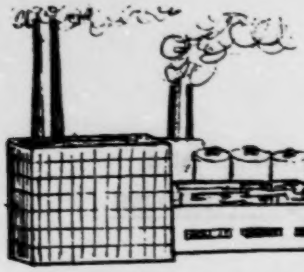


Naturally a household produces a smaller amount of waste than a factory or a business does.

According to the law (Resource Conservation and Recovery Act, see P.116), the term "hazardous waste" does not apply to normal household quantities of any substance, even if it is dangerous or highly toxic.

The difference between what is normally called "hazardous waste" and what we are calling "household hazardous waste" relates not so much to the level of toxicity, but to the quantities of waste involved. Household hazardous wastes are smaller amounts of hazardous wastes. We should remember, however, that some of the most hazardous materials used or produced by industries or commercial establishments are not available to the average household.

Businesses and industries that produce hazardous waste have to make special arrangements to dispose of it at a HAZARDOUS WASTE DISPOSAL SITE. Most hazardous waste from Washington state is all transported to the Hazardous Waste Site in Arlington, Oregon, which is operated by Chem-Securities Systems, Inc.

WHAT IS A CHEMICAL?

Toxic substances, like all substances found on the planet, are CHEMICALS. Chemicals are difficult to talk about because different people have different ideas about what the word "chemical" means. Some people think of chemicals as "a smelly liquid in a jar". But to scientists the term "chemical" means a lot more. You should take a chemistry class if you wish to understand exact definitions, but you don't need to be a chemist to understand some simple ideas about the term "chemical".

CHEMICALS are made of lots of little pieces that can join together in different ways. Different combinations and arrangements of these pieces will form different CHEMICAL COMPOUNDS. And each different arrangement or combination of pieces will behave in a different way.

A good way to understand what chemicals are like is to take a handful of Legos® and see how many ways there are of putting them together. Some combinations stay together better than others. Some combinations of pieces are not possible. Different arrangements make different shapes.

Everything we can see, feel, smell or touch is made of chemicals -- the dirt, the air, the ocean, fish, whales, birds, potatoes and typewriters.

Many chemicals occur naturally. But people, using energy and human ingenuity, have also found ways to rearrange the pieces in these naturally occurring chemicals.

Sometimes we do this to produce more of a chemical that occurs naturally. For instance, Vitamin C, a chemical that occurs naturally in oranges and other fruits and vegetables, can also be made in a laboratory by rearranging pieces from other chemicals.

Other times energy and ingenuity are used to make altogether new chemicals -- to create an arrangement that does not occur in nature. Plastics are an obvious example of a type of chemical that does not occur naturally.

Over the course of millions of years "nature" has evolved ways of dealing with and recycling "natural" chemicals. Or rather, one might say that the types of organisms that have survived to the present day have done so because of this ability.

This is not to say that natural poisons have not killed or injured a number of individuals during the course of the millennia! But it does mean that there are no species around whose long term survival as a species is threatened by a natural toxin in its particular environment.

During a very long, slow evolutionary process, the chemical relationships between all the various living and non-living elements of the environment (including human beings) have been established.

People have been producing "new" chemicals in significant quantities for less than 50 years. Our environment is now filled with chemicals that we and other living organisms have no evolutionary experience dealing with.

It is one of the great challenges of our time to identify and discriminate between the new chemicals that are beneficial and those that are destructive.

If we are prepared to accept the presence of some hazardous chemicals because of their redeeming benefits (and deciding where the balance lies between risk and benefit is a topic widely discussed) -- then we must be prepared to accept the responsibility and cost of containing these chemicals (and the toxic by-products of their manufacture) in such a way that their long-term as well as their short-term effects are acceptable.

Which is where we get back to disposal.

One of the ways to learn about a new topic is to find out how much you already know. Sometimes you know only a little. Sometimes you know more that you thought you did. Sometimes you learn new bits of information. Other times you discover questions you hadn't thought of asking...yet.

INTRODUCTORY QUIZ: How Much Do You Know About Household Hazardous Waste?

Go ahead! Test your brain and your educated guesser. When you come across a word or phrase that is underlined, it means that it will reappear in this series of lessons. If you don't know anything about that idea or topic now, you probably will when you have finished some of the activities in this book.

1. In 1975, how many billion gallons of motor oil were used and ultimately disposed of in the U.S? a. .5 b. 1.5 c. 2
2. What is the main ingredient in antifreeze? ____________
3. Do you live on a sewer line or do you have a septic tank?______
4. About how much liquid or powdered drain cleaner is used by the average homeowner in a week?____________
5. Is the catch basin or grate in front of your house a good place to pour the used oil from your car?__________
6. What does the designation LD_{50} mean?____________________
7. What is Metro?____________________________________
8. Where does your trash go when it is collected?____________
9. How many transfer stations does King County have?__________
10. How many landfills does King County have that might be used by homeowners?__________
11. What federal agency is responsible for regulating pesticides?
____
12. Do you know where something will end up if you throw it in the street catchbasin? ________
13. Would it be against Metro regulations to flush paint thinner down your toilet?____________
14. Could antifreeze be poisonous to fish?__________
15. Who would you call if you saw someone dumping a large quantity of a pesticide in a stream near your house?
16. If you pour something down the sink, where does it end up?
____
17. Why is Metro interested in household hazardous waste?
18. True or False: The law requires a pesticide container to have a warning regarding any precautions about use or misuse.
19. What does toxic mean?

INTRODUCTORY QUIZ: cont.

20. About how much garbage per day is generated in King County?

____

21. What is a pesticide?________________________________

Is weed killer a pesticide?________

Is wood preservative a pesticide?________

22. On a list of the 194 most used/purchased supermarket grocery products in 1978, how do you suppose the following items were ranked? (Number 1 was the most purchased--number 194 was the least purchased)

soaps and detergents_____
bathroom cleaners_____
drain cleaners_____
household cleaners____
air fresheners/deodorizers_____
toilet bowl cleaners______

23. What does E.P.A. stand for?________________________________

24. On a toxicity rating scale of 1-6, 1 being practically non-toxic and 6 being very highly toxic, how do you suppose the following might be rated?

turpentine________
glass/window cleaner ________
antifreeze________
toilet bowl cleaner________
oven cleaners_____
latex wall paint_______

25. How many pounds of pesticides are sold annually in the U.S.?

a. 500 lbs. b. 1 million lbs. c. 1 billion lbs d. 6 billion lbs.

26. What percent of that amount was purchased by home and garden users?

a. 10% b. 15% c. 20% d. 25% e. 50% f. 75%

27. In 1972, the state of Washington generated 18.6 million gallons of waste oil. How much of this was waste motor oil? (in million gallons.) a. 2.1 b. 5.9 c. 10.6 d. 12.5

28. What percent of all households use pesticides in their home, garden, or yard?

____

- ANSWERS -

INTRODUCTORY QUIZ: How Much Do You Know About Household Hazardous Waste?

Go ahead! Test your brain and your educated guesser. When you come across a word or phrase that is underlined, it means that it will reappear in this series of lessons. If you don't know anything about that idea or topic now, you probably will when you have finished some of the activities in this book.

1. In 1975, how many billion gallons of motor oil were used and ultimately disposed of in the U.S? a. .5 [✓ b.] 1.5 c. 2
2. What is the main ingredient in antifreeze? ethylene glycol
3. Do you live on a sewer line or do you have a septic tank? ______
4. About how much liquid or powdered drain cleaner is used by the average homeowner in a week? 3.49 grams
5. Is the catch basin or grate in front of your house a good place to pour the used oil from your car? no
6. What does the designation LD$_{50}$ mean? lethal dose - 50% of the subjects died
7. What is Metro? regional agency responsible for transit, sewage treatment and water quality.
8. Where does your trash go when it is collected? —
9. How many transfer stations does King County have? 6
10. How many landfills does King County have that might be used by homeowners? 4
11. What federal agency is responsible for regulating pesticides? E.P.A.
12. Do you know where something will end up if you throw it in the street catchbasin? stream, creek, lake, puget sound
13. Would it be against Metro regulations to flush paint thinner down your toilet? yes
14. Could antifreeze be poisonous to fish? yes
15. Who would you call if you saw someone dumping a large quantity of a pesticide in a stream near your house? DOE
16. If you pour something down the sink, where does it end up? sewer system → Puget Sound or septic tank
17. Why is Metro interested in household hazardous waste? As the agency responsible for sewage treatment and water quality, Metro is studying toxicants in the treatment plants and local waters, including toxicants coming from households!
18. [✓ True] or False: the law requires a pesticide container to have a warning regarding any precautions about use or misuse.
19. What does toxic mean? poisonous

- ANSWERS -

20. About how much garbage per day is generated in King County?
about 3,237 tons per day.

21. What is a pesticide? any chemical used to prevent, repel, or kill pests, including insects, rodents, fungi or weeds.
Is weed killer a pesticide? yes
Is wood preservative a pesticide? yes

22. On a list of the 194 most used/purchased supermarket grocery products in 1978, what number do you suppose were the following? (Number 1 was the most purchased--number 194 was the least purchased)

soaps and detergents 2
bathroom cleaners 44
drain cleaners 84
household cleaners 28
air fresheners/deodorizers 59
toilet bowl cleaners 51

23. What does E.P.A. stand for? Environmental Protection Agency

24. On a toxicity rating scale of 1-6, 1 being practically non-toxic and 6 being very highly toxic, how do you suppose the following might be rated?

turpentine 3-4
antifreeze 3
oven cleaners 3
glass/window cleaner 2
toilet bowl cleaner 3-4
latex wall paint 2

25. How many pounds of pesticides are sold annually in the U.S.?
a. 500 lbs. b 1 million lbs. [✓ c. 1 billion lbs] d. 6 billion lbs.

26. What percent of that amount was purchased by home and garden users?
a. 10% [✓ b. 15%] c. 20% d. 25% e. 50% f. 75%

27. In 1972, the state of Washington generated 18.6 million gallons of waste oil. How much of this was waste motor oil? (in million gallons.) a. 2.1 b. 5.9 [✓ c. 10.6] d. 12.5

28. What percent of all households use pesticides in their home, garden, or yard? 90%

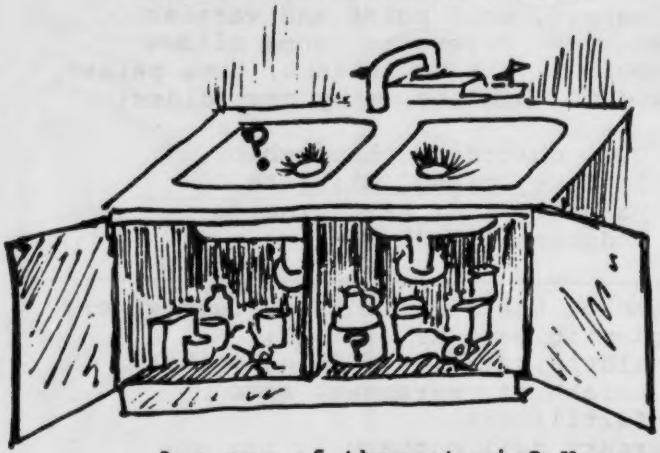
OVERHEAD

WHAT'S IN YOUR HOUSE?

Hazardous household wastes can be found in many places in the home. The Inventory will help you discover some of those places.

All of us who use these products know how beneficial they are. But might they also harm us? or others?

PET FLEA COLLARS
TOILET BOWL CLEANERS
SLUG BAIT
LAUNDRY SOAP
WEED KILLERS
OIL
ANTIFREEZE
BRAKE FLUID
LATEX PAINT
ROOM DEODORIZERS
OVEN CLEANERS
GLASS AND WINDOW CLEANERS
FLOOR POLISH
ROACH SPRAY
PAINT THINNER
MILDEW PROOFING
LACQUER THINNER
WOOD PRESERVATIVES
RAT POISON
NO-PEST STRIPS
MOTHBALLS
DISINFECTANT CLEANERS
POWDERED BLEACHES
SCOURING POWDER
DRAIN OPENERS
STAINS/VARNISHES
ENAMEL PAINTS
FURNITURE POLISH
PAINT STRIPPERS



Are any of these toxic? How would you know?
Where do they go when they leave your house?
Are you ready to be a SLEUTH and find out?

OVERHEAD

can some of your household products harm you?

	TOXICITY RATING	LETHAL DOSE FOR 150 lb. HUMAN	HOUSEHOLD PRODUCTS.....
1	Practically Non-Toxic	More than 1 Quart	foods, candies, 'lead' pencils, eye makeup
2	Slightly Toxic	1 Pint to 1 Quart	dry cell batteries, glass cleaner, deodorants and anti-perspirants, hand soap
3	Moderately Toxic	1 Ounce to 1 Pint	antifreeze, automotive cleaners, household bleaches, many detergents, dry cleaners, most floor cleaners, metal cleaners, most oven cleaners, many general cleaners, most fuels, lubricating oils, most stain and spot removers, many disinfectants, floor polish, shoe polish, most paints.
4	Very Toxic	1 Teaspoon to 1 Ounce	most toilet bowl cleaners, some deodorizers, engine motor cleaners, some fertilizers, some paint brush cleaners, some paint and varnish removers, fireworks, some mildew proofing, air sanitizers, some paints, lacquer thinners, many pesticides: DDT, chlordane, heptachlor, lindane, mirex, diazinon, malathion, diquatdibromide, endothall, 2,4D.
5	Extremely Toxic	7 drops to 1 Teaspoon	some of the insecticides, fungicides, rodenticides, herbicides: aldrin, eldrin, bidrin, methyl parathion, paraquat, some fertilizers, mercury cell battery
6	Super Toxic	a taste (less than 7 drops)	a few pesticides like: paroxon, phosdrin, parathion, isobenzan, pyrazoyan

Gosselin et al. (1976) Clinical Toxicology of Commercial Products.

section I

MASTER SLEUTH

TEACHERS:

The MASTER SLEUTH is an activity that lets the student explore several ideas of what might happen when they dispose of a waste household product. Depending on the grade level, students could be lead through the activity or allowed to "sleuth" alone or in small groups. The Key to the Master Sleuth is the MASTER SLEUTH CHART (p. 14-16)--you may want to post it to keep everyone on track. You may also want to cover some of the information called EVIDENCE before the students embark on the Sleuth.

The following Master Sleuth Directions may be read out loud or copied and handed out to the students.

MASTER SLEUTH DIRECTIONS:

The purpose of the MASTER SLEUTH is to help you decide on the best disposal choices for your household hazardous wastes.

A sleuth is a detective or a bloodhound. Sleuthing means to track or trail something. This activity asks you to be a detective and to track your household wastes. You will learn where they go, what happens when they get there, and what they can do to the creatures they meet on the way.

Let's say you have a particular household product that you wish to get rid of. There are, of course, several things you could do with it. Most people would choose the easiest and most obvious. Wouldn't you? Once you get rid of it, you don't have to worry about it any more! Or do you?

In terms of the best way to dispose of these wastes, we are all beginners. Every day somebody learns something new about what substances are hazardous or toxic, about how to make them less so, about how they affect the lives of fish or caterpillars....about how they change our world. We are very knowledgeable in some ways, but we also have a lot to learn about this very complicated subject.

The MASTER SLEUTH will introduce you to some of these complexities. As you go through it you will gather evidence about the possible results to you, or to the rest of the world as we continue to dispose of waste in the usual ways.

We have suggested five SLEUTH PROBLEMS for you on the next page. If you like, however, you can select a product from your own home after you do the HOUSEHOLD INVENTORY (p. 130). Or you can select a product from the list entitled "What's In Your House?" (page 9).

MASTER SLEUTH DIRECTIONS (continued)

The MASTER SLEUTH CHART (pp. 14-16) lists 14 QUESTIONS as steps to help you gather evidence about the possible results of the way you dispose of waste. These 14 steps take you all the way from "Reading the Label" to "Deciding Whether You are Happy with Your Disposal Choice."

Some of the QUESTIONS will be easy to answer, for example, "How much have you got to get rid of?" Other questions, however, will be more difficult and you will want some more information to help you answer them. We have included some of this informatoin on reference sheets which we have called EVIDENCE.

The EVIDENCE (pp. 22-59) will be a map, or fact sheet, that will explain a difficult term or process to you. The "Product Tables" (pp. 139-147) are also important pieces of Evidence.

Each step of the SLEUTH will tell you what the EVIDENCE or pieces of evidence are that you will need for that QUESTION. The pieces of

EVIDENCE **1a,b** are numbered the same as the QUESTION **1**.

You will not be able to fill in the answers for all of the questions. To give you suggestions or where to find more information, or what kind of educated guesses you could make, or what pieces of information are still unknown, we have provided you with a section called MISSING EVIDENCE (pp. 17-19). You might want to glance at it before beginning so that you understand why you may have to leave some questions unanswered.

Finally, you will want to discuss or compare your conclusion on DISPOSAL OPTION/TRADEOFFS with the rest of your class.

Happy sleuthing.....

SLEUTH PROBLEMS

I. You have just changed the oil in your car, and now you have a pan of used oil that you need to get rid of.
Many people pour used oil down the storm drain in the street, or out onto the dirt in the backyard. What are the advantages and/or disadvantages of these disposal options?

II. You decide to paint the woodwork in your bedroom with a brightly colored enamel paint. When you're done, you pour some brush cleaner into an empty can and clean your brush. Now you have paint contaminated solvent to get rid of. You decide to flush it down the toilet. Was this a good choice? Why, or why not?

III. After you finished painting your room you put the 3/4 empty can of paint in the basement, but you didn't put the lid on tightly enough. When you go back a couple of months later to use the paint for some touch-up work, it has all but dried up. Annoyed, you throw the can of dried up paint in the trash can.

IV. You live in rural King County, out of range of Metro's sewer system. Your house is on a septic tank. It is time to drain your car radiator which contains, of course, water and antifreeze. You don't want to let it run out onto the driveway as you know that the sweet taste of antifreeze may attract and poison your dog. You heard a neighbor say she pours her antifreeze on her fence posts as a preservative. You wonder whether to do this, or whether you should simply pour it down the sink. Which will you choose? Is there a better alternative?

V. Your neighbor's kitten got sick from licking her feet clean after walking across a lawn that had recently been treated with weed-killer. You realize that it would not be so good for your little brother, Bobby, either, who spends a lot of time crawling around on the grass. You persuade your parents that a few dandelions are a small price to pay for Bobby's well-being, and that they should get rid of the 25 lb. bag of 2,4-D (powder pesticide) in the garage. And they might as well get rid of the container of DDT that has been sitting around unused since it was banned in 1970.

But what to do with these pesticides? You think the trash would be the best place to throw them. Do you still think so after going through the sleuth?

MASTER SLEUTH

Start

1

WHAT DO YOU HAVE?

EVIDENCE: Read the Label (1 a)
The Label must tell you..(1 b)

What are the active ingredients?

Are there any precautions or comments regarding use or disposal?

2

HOW MUCH DO YOU HAVE?

MISSING EVIDENCE?

3

HOW WILL YOU DISPOSE OF IT?

Choose the best one...

Trash?
Sink or toilet?
Storm drain
"The Ditch"?
Backyard?
(on plants or bury)
Other?______________

your choice______________
IS IT LEGAL?
yes no

EVIDENCE: Is it legal? (3)

4

WHERE WILL IT GO FIRST?

Check the immediate destination

✓		Do you know which one?	EVIDENCE
	Landfill		4 a
	Sewer		4 b
	Septic tank		4 c
	Waterways		4 d
	Soil	(backyard)	continue...

next page

5 AND NOW....DEPENDING ON ITS PHYSICAL CHARACTERISTICS...

State? ______
(is it liquid, solid, or gas?)

Solubility? ______
(does it dissolve in water?)

Volatility? ______
(how fast does it evaporate?)

6 ...AND WHERE YOU SENT IT.....

✓	Where?	EVIDENCE: see...
	Landfill	Leachate (6a)
	Sewage	Treatment Plant (6b)
	Storm sewer	Movement in soil and water (6c)
	Soil	
	Groundwater	

next page

7 WHAT WILL BE ITS ENVIRONMENTAL FATE?

✓	Whereabouts?		
	Soil	=	EARTH
	Sludge		
	Sediment		
	Groundwater	=	WATER
	Streams/Lakes		
	Oceans		
	Air	=	AIR

MISSING EVIDENCE?

EVIDENCE: (8)

1. How long will it persist? ______ ¡
2. Will it accumulate?

MISSING EVIDFNCE?

AND NEXT.....DEPENDING ON ITS CHEMICAL NATURE....

8 HOW WILL IT CHANGE?

9 IMAGINE WHAT LIVING CREATURES ARE LIKELY TO COME INTO CONTACT WITH THE WASTE....

Living Creatures...	yes	no
Plants?		
Micro-organisms?		
Insects?		
Fish?		
Birds?		
Mammals?		

MISSING EVIDENCE?

10 ... AND HOW DO TOXICANTS GET INSIDE ANIMALS AND PLANTS?

MISSING EVIDENCE?

11 ONCE INSIDE...WHAT WILL HAPPEN TO IT?

yes	no	
		Excreted unchanged?
		Metabolized and excreted?
		Go into storage?

12

WILL IT BIOCONCENTRATE?

MISSING EVIDENCE?

13

COLD IT CAUSE IMMEDIATE OR LONG TERM HARM TO ...

	Acute Immediate		Chronic Long term	
	yes	no	yes	no
Plants				
Micro-organisms				
Insects				
Fish				
Birds				
Mammals				

MISSING EVIDENCE?

14

ARE YOU HAPPY WITH
THE DISPOSAL CHOICE
YOU MADE?

IF NOT, GO BACK TO #3 AND TRY ANOTHER OPTION. (CONCLUSION P.60)

missing evidence

As you investigate your product through the Sleuth, you will undoubtedly come upon questions which have no answers. There are a couple or reasons for this, either:

1) the information wasn't included in this book, due to lack of space, or complexity of the answer, or
2) no one knows the answers yet.

This lack of information is called MISSING EVIDENCE. This little "Help" man is the symbol that means there is missing Evidence. When you see one, check back on pages 19, 20 or 21, and look for a number that corresponds to the section of the MASTER SLEUTH that you are on. It may provide you with an explanation of why there is Missing Evidence.

What should we do when we don't know? The next page (p. 18) will help you out when you find some Missing Evidence.

missing evidence

WHAT DO YOU DO WHEN EVIDENCE IS MISSING?

In the following boxes, write what you think you or anyone else should do when:

WHEN	WHAT SHOULD WE ALL DO WHEN WE DON'T KNOW?
A lot of people in your community know what should be done with household hazardous wastes, but you don't know.	
A lot of experts know, but you find the subject difficult to understand.	
Research on which chemicals are benign or toxic is often contradictory. Experts disagree on the doses that are harmful & on the effects.	
Information exists but it is difficult to find. You don't know what computer or specialized library to contact.	
Information is unavailable to the general public. Some manufacturers don't release content information for a product, claiming it is a trade secret.	
Different people know different parts of the answer. Some know how a chemical affects bees, others know how it acts in water, etc.	
Very few people know the answer. Experts somewhere may know, but you don't know them or where they are.	
No one knows.	

missing evidence

FOR THE MASTER SLEUTH

1

Manufacturers of some everyday substances -- particularly household "cleaners" -- do not have to list the ingredients in their products.

Look at some common cleaners in your local supermarket. You will see that some list ingredients, and some do not. Some labels mention one or two ingredients only, or just use a very general term (such as "petroleum distillate") which doesn't mean much.

The reason manufacturers do not have to list their ingredients is because such information is a TRADE SECRET. It is a tradition of free market enterprise that manufacturers can own knowledge about how to make a particular product. This prevents other companies from using the information to make an exactly similar product which would compete in the market-place.

Ingredients for specific products are available to doctors at poison control centers, so that they know how to treat someone in the case of poisoning.

Unfortunately trade secrets means that we, the users, cannot find out exactly what it is we are using. It is a piece of missing evidence for those of us who want to make decisions about exposing ourselves or our environment to certain chemicals.

7

It is important to realize that once a substance (with relatively few ingredients) is let out of its jar or can and distributed into the environment, it is now in a very much more complex situation.

A MIXTURE of wastes from many sources accumulates in the sewers, septic tanks and landfills, in oceans, lakes, streams and sediment.

Sixty thousand different chemicals are manufactured by humans each year.....and that doesn't count all the "natural" chemicals. Not only are there a MULTITUDE OF CHEMICALS...there are also a MULTITUDE OF CONDITIONS.

Some places are hot and some are cold; some places are wet and some dry; sometimes conditions are acid and sometimes alkaline; different concentrations of the same chemicals occur in different places; everywhere there are different species of plants, micro-organisms and other animals.

Chemicals can behave and change very differently under varying conditions.

Chemists can do tests in laboratories. Two or three - or even more-chemicals may be mixed together to see how they react. One or more chemicals may be tested under several different conditions

Chemists can also look at the structures of chemicals and make predictions about how they will react with each other, and what might happen under different conditions.

While these tests and predictions can give some useful answers about relatively simple situations, it is impossible to reproduce the ever-changing complexity of the real environment, and so there will always be unanswered questions about whether actual behavior is the same as tests suggest.

8 As was made clear in the previous piece of missing evidence a laboratory is not the real world. PERSISTENCE TIMES and DEGRADATION PATHWAYS for any one chemical will differ according to local conditions. Of particular importance is the presence or absence of different species of micro-organisms.

Scientists are only just beginning to study the subject of "microbial transformation" of chemicals. They are studying how micro-organisms, such as bacteria and fungi, act on certain chemicals to break them down. In some cases, micro-organisms change chemicals into new substances whose persistence or toxicity has not been determined.

However many studies are done, we will never have complete answers in every situation, just because of the enormous complexity of possibilities that are out there.

10 For many of the chemicals that we are exposed to, scientists do not know exactly how they act inside us -- or inside other living creatures. It is a very tricky business trying to find out just exactly what kinds of changes happen inside a living body.

In addition, there is the whole question of how an organism will respond when exposed to several different chemicals at the same time.

So in some cases, we have insufficient evidence. We do not know exactly how a particular substance is metabolized or what biochemical processes it interferes with.

12 Bioconcentration is not something you notice right away. It took us thirty years of spraying DDT before we found out that it was working its way up the food chain and reaching high concentrations in predatory bird species such as peregrine falcons. The effect of these high concentrations was to make the birds' eggshells too thin so that they kept cracking.

Since then we have been much more aware that persistent, slowly metabolized chemicals will patentially bioconcentrate. But we will not always know what the unfortunate results are going to be until after they happen.

13 A rat is not a human. For those of us who are primarily concerned with how chemicals will harm people, we should be aware that rats, monkeys, rabbits and pigs are the kinds of animals upon whom most chemicals are tested for both chronic and acute toxicity.

Many times human bodies respond to chemicals in the same way that other mammals do. But there are significant differences that may seriously affect the comparisons. or example, rats (on whom many of the tests are done) cannot vomit or miscarry. Rats, however, can make Vitamin C out of other chemicals inside their own bodies, but people cannot. We have to get Vitamin C from foods that we eat. Vitamin C is a chemical that the body uses a lot to detoxify poisons. The more poison a person gets, the more Vitamin C gets used up. A rat can make more if it needs it.

So we don't know for sure whether animal tests will always give complete information about what can happen in humans.

Response to dose is another thing that can very considerably from one type of animal to another. It turned out sadly that humans were much more sensitive to the drug thalidomide than the animals it had been tested on.

EVIDENCE begins on the next page

EVIDENCE:
WHAT DO YOU HAVE?

1a

READING THE LABEL

The first thing that you want to do is READ THE LABEL. It will give you the information for Question 1.

1. What is the Brand Name of your product?______________________

2. What is this product used for?______________________

3. How does this product work?______________________

____

Background: Active Ingredients. The active ingredients are the chemicals responsible for the functional effects of the product. For example, in a pesticide, the active ingredient is the chemical that actually kills pests.

The active ingredient may only be a small percentage of the total content. The rest of the product (inert ingredients) is made up largely of a vehicle--a substance that carries the active ingredients in a form that makes it easy to apply or use. Such things as perfume or coloring agents are also considered inert ingredients.

Although we have for the most part considered only active ingredients in the Product Tables, it is important to remember that "inert" only means inactive in relation to the intended function of the product. It does not mean that the inert ingredients are necessarily harmless to humans or the environment.

4. What are the active ingredients in this product?

5. How should this product be used or applied? (List all pertinent directions)

6. Are there any precautions given?

7. Are there any indications that this product is toxic or hazardous?

Now you should have the EVIDENCE you need to fill in QUESTION 1 on the SLEUTH. If that is the case, go on to QUESTION 2.

However, if you don't have the EVIDENCE you need, go to MISSING EVIDENCE? to see if there is some information that will help you.

EVIDENCE:
WHAT DO YOU HAVE?

THE LABEL MUST TELL YOU....

In the 1960's, the Federal Hazardous Substance Act was signed into law in an effort to protect consumers from hazardous consumer products.

The Act, now administered by the Consumer Product Safety Commission, provides for labeling of all products that are, or contain, a hazardous substance. The Act requires information on that label concerning safe use and first aid treatment. A hazardous substance or mixture is described as highly toxic or toxic; flammable or combustible; corrosive; an irritant; a strong sensitizer; radioactive; or capable of generating pressure and causing substantial harm.

The labels required must be of specific size and contain certain information:

1. A signal word: DANGER on those products that are extremely flammable, corrosive, or highly toxic; and WARNING or CAUTION on all other hazardous substances that are required to bear a label.
2. The additional word POISON and the skull and crossbones symbol on highly toxic and other specifically named substances.
3. A description of the principal hazards involved in using the product, such as VAPOR HARMFUL, FLAMMABLE, etc.
4. A statement of measures the user should take to avoid the hazard, such as USE ONLY IN A WELL-VENTILATED AREA.
5. A list of the COMMON NAMES of the hazardous ingredients. If a hazardous substance has no common name, the chemical name will be used.
6. If necessary, instructions for SAFE HANDLING and STORAGE.
7. FIRST AID instructions.
8. Name and location of the MANUFACTURER, DISTRIBUTOR or REPACKER.
9. The statement KEEP OUT OF THE REACH OF CHILDREN or its equivalent.
10. Any additional information that the Commission finds necessary to protect the public health.

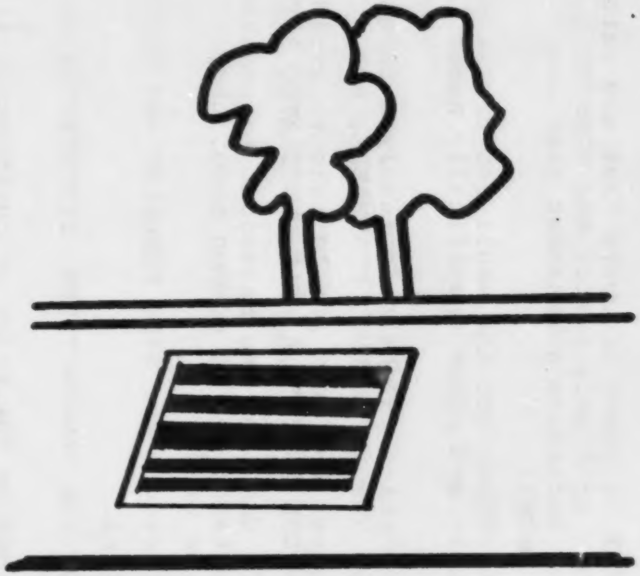
Were you able to get the information or evidence you needed from your label?

If not, check MISSING EVIDENCE?

HOUSEHOLD WASTE:

AVAILABLE DISPOSAL MEANS

INCINERATOR



STORM DRAIN

RECYCLING CENTER

TOILET

SINK

WEEDS

GARBAGE

HOLE IN THE GROUND

3

EVIDENCE:
HOW WILL YOU DISPOSE OF IT?

IS IT LEGAL?

Several local agencies have regulations as well as recommendations regarding the disposal of hazardous wastes. As you consider the question "How Will You Dispose of It?" you will want to ask yourself:

IS IT LEGAL?

Each of the disposal options: sewer, storm drain, creek, septic tank, ground, or trash, is covered here in some way. Read the following descriptions and then answer the question.

CAN YOU DISPOSE OF YOUR PRODUCT IN THE SINK OR TOILET?

First, you have to decide whether you are on a sewer collection line or on an individual septic tank. (See Number 4.)

Metro says that you cannot put any of the following down your drain:

- --flammable or explosive materials. For example, fuel oil, waste crank case oil, gasoline, naptha, benzene, toluene, etc.
- --obstructing materials. For example, ashes, sand, grass, etc.
- --odorous materials capable of creating a public nuisance.
- --toxic vapors. For example, chlorinated hydrocarbons, cyanide, sulfur dioxide, hydrogen sulfide.
- --corrosive materials capable of causing structural damage. This includes waste with a pH of less than 5.5.

These and additional regulations pertain more to large industrial wastes, obviously, but would also include household quantities.

Seattle/King County Health Department says that pesticides and toxic wastes shall not be disposed of as a waste into a sanitary sewage system or individual septic tank.

City of Seattle sewer ordinance prohibits wastewater containing toxic or poisonous substances in quantities that would affect recovery water or sewage treatment plants.

CAN YOU DISPOSE OF YOUR PRODUCT DOWN THE STORM DRAIN? THE "DITCH"?

If your storm drain is attached to a sewer system, as in some places in the City of Seattle, the Metro regulations would apply. If your storm drain and ditch go to a lake or Puget Sound, then the following law might apply:

The Washington State Department of Ecology says it is unlawful for any person to throw, drain, run, or discharge any organic or inorganic material into the waters of this state that shall cause or tend to cause pollution of those waters. Organic materials would include oil-based paints, solvents, blood, petroleum-related products such as gasoline, crude oil, diesel oil, sludge, oil refuse.

Inorganic materials would include salts and battery acid.

CAN YOU DISPOSE OF YOUR PRODUCT BY BURYING IT IN THE BACKYARD?

Seattle/King County Health Department says that it is legal for an individual to bury wastes from his own activities in ground that he owns or leases unless it creates a nuisance, attracts rats and insects, or contaminates groundwater.

The King County Fire Department says it is not legal to dig a hole and bury any flammable liquid, or to throw any flammable liquid on the ground to evaporate.

CAN YOU DISPOSE OF YOUR PRODUCT BY BURNING IT?

It is illegal to do any open burning of garbage, yard clippings or branches, or any other materials without a permit from the Fire Department. This comes through the requirements of the Puget Sound Air Pollution Control Agency.

CAN YOU DISPOSE OF YOUR PRODUCT IN THE TRASH?

Both King County Solid Waste and City of Seattle operate sanitary landfills. They will not take liquids, demolition debris (except at appropriate places), flammable or hazardous materials. Hazardous materials are toxic, ignitable, radioactive, or reactive. They also don't want to take tires since they "pop up" in the landfill because of the air pockets they create when buried.

EVIDENCE:
WHERE WILL IT GO FIRST?

4a

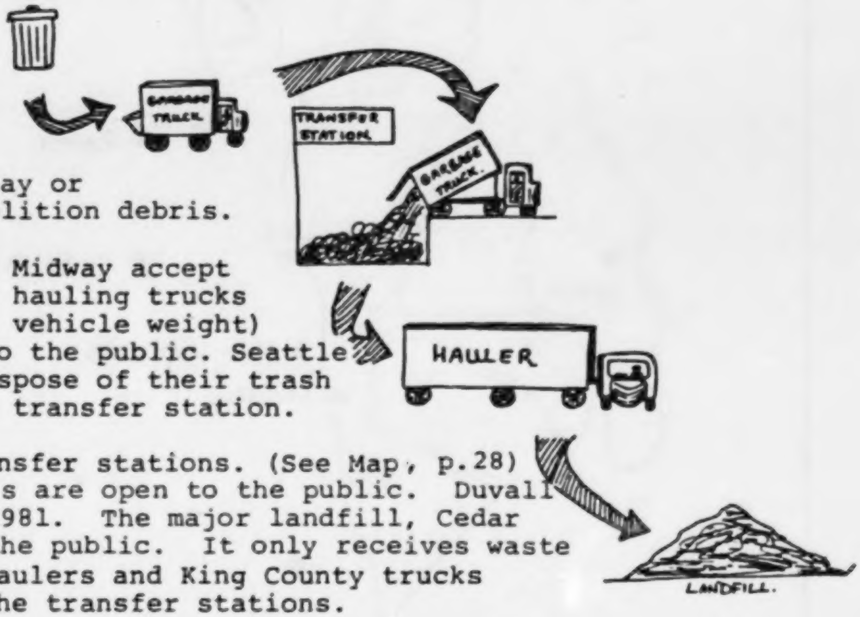
GARBAGE DUMPS AND LANDFILLS

Once you have put your trash in the garbage can, you don't have to think about it much any more. The garbage truck comes by and takes it away every week. But where does it go then?

If you live in the CITY OF SEATTLE, the garbage trucks take your trash to one of the city's two transfer stations, Fremont or South Park. (See the Map: Garbage Dumps and Landfills, p. 28). From there it is picked up by larger trucks and carried to the Kent-Highlands landfill.

If you live in ANOTHER PART OF KING COUNTY (outside Seattle City limits), your garbage will go to King County transfer stations and then to one of the King County landfills.

A transfer station is just what the name suggests. It is a place where garbage is brought in and deposited, and waits until it can be taken to its final resting place--the landfill. Some transfer stations have different areas: one spot is for demolition debris, or grass and lawn clippings, and another for household garbage.



The City of Seattle has two transfer stations and two landfills. The Midway landfill takes only waste that will not decay or decompose, such as demolition debris.

Both Kent-Highlands and Midway accept garbage from commercial hauling trucks over 12,000 tons (gross vehicle weight) only and are not open to the public. Seattle citizens who want to dispose of their trash themselves must go to a transfer station.

King County has six transfer stations. (See Map, p.28) In addition, 4 landfills are open to the public. Duvall was closed in June of 1981. The major landfill, Cedar Hills, is not open to the public. It only receives waste brought by commercial haulers and King County trucks carrying garbage from the transfer stations.

All together, the smaller landfills receive only 1/17 of the total amount of solid waste that comes through the King County transfer stations.

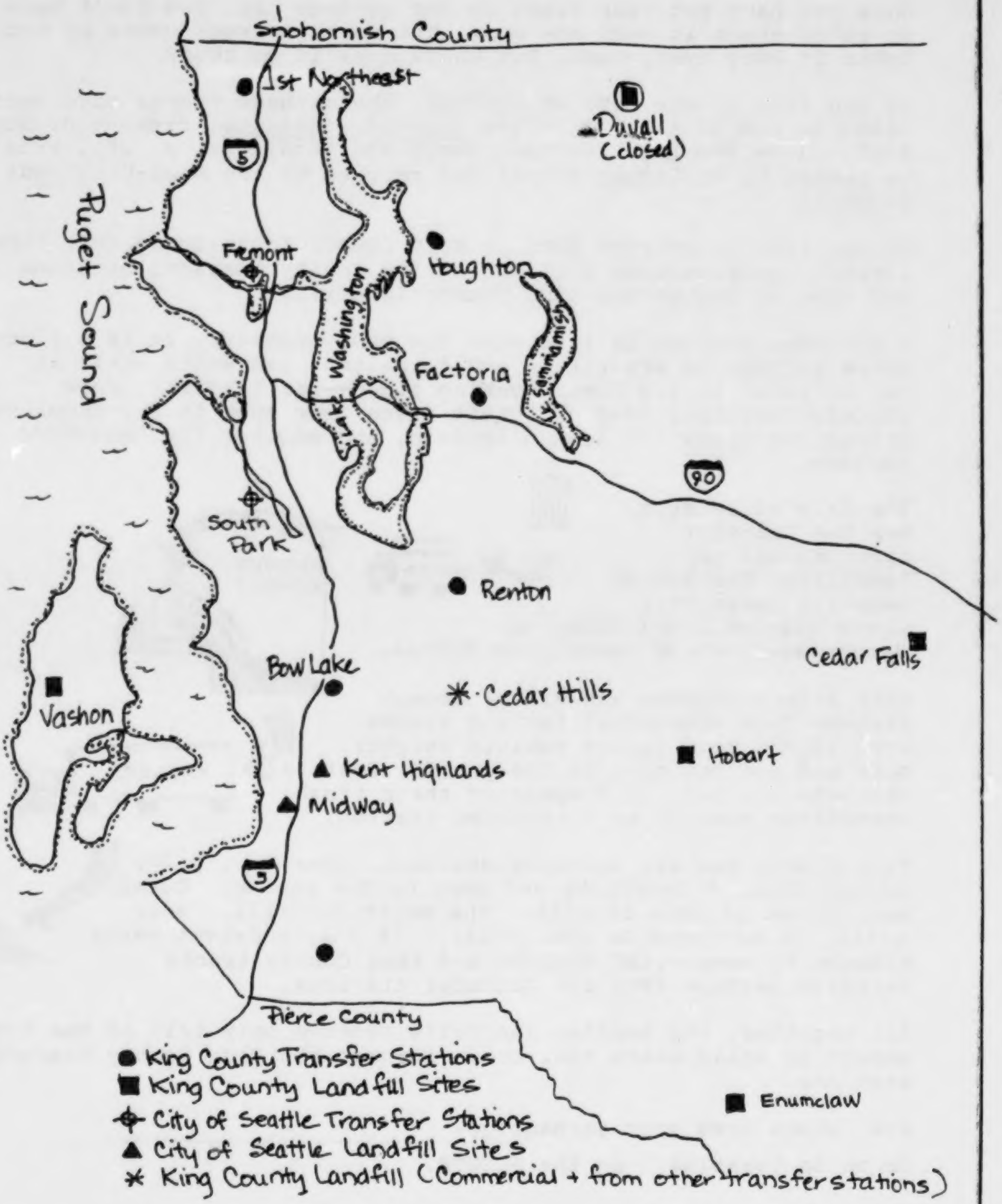
Now, where does your garbage go?____________________________

Go on to Question 5 on the SLEUTH.

EVIDENCE:
WHERE WILL IT GO FIRST?

4a

Garbage Dumps and Landfills



SEWERAGE SYSTEM

When you pour something down the sink or flush it down the toilet, have you ever wondered what happens to it next?

If you don't live too far out in the country, chances are that it goes through the pipes in your building and on into the SEWERS. (If not, turn to 4c).

The SEWERS are a system of underground pipes that collect liquid waste from each house, hotel, store, office building, factory and so on, and bring it all together into huge pipes called TRUNK LINES.

By the time it gets to the TRUNK LINES you've got a big mess of everybody's mixed waste (called SEWAGE) rushing along.

Just think for a minute of all the appliances and fittings in your home that are connected to the sewers. And try to list in your mind all the things that you wash down into the sewers.

Not all that long ago sewage used to be dumped directly into rivers, lakes and oceans.
Can you think of some reasons why this might become a problem after a while?

Now cities and towns have SEWAGE TREATMENT PLANTS (See P. 39) to clean the sewage up before discharging it.

If you live in or around Seattle you are probably on Metro's sewer system. Metro is short for Municipality of Metropolitan Seattle. (Yes, that is the same agency that runs the bus system!)

Just as with garbage collection, the people who use the sewer system are the ones who pay for it. Bills come in the mail.

The map on the following page shows Metro's service area. If you live in that area you can use the map to trace the route from your neighborhood to a treatment plant.

The map shows the main trunk lines only. It does not show all the small pipes going to each street, but you should be able to locate the trunk line nearest to where you live.

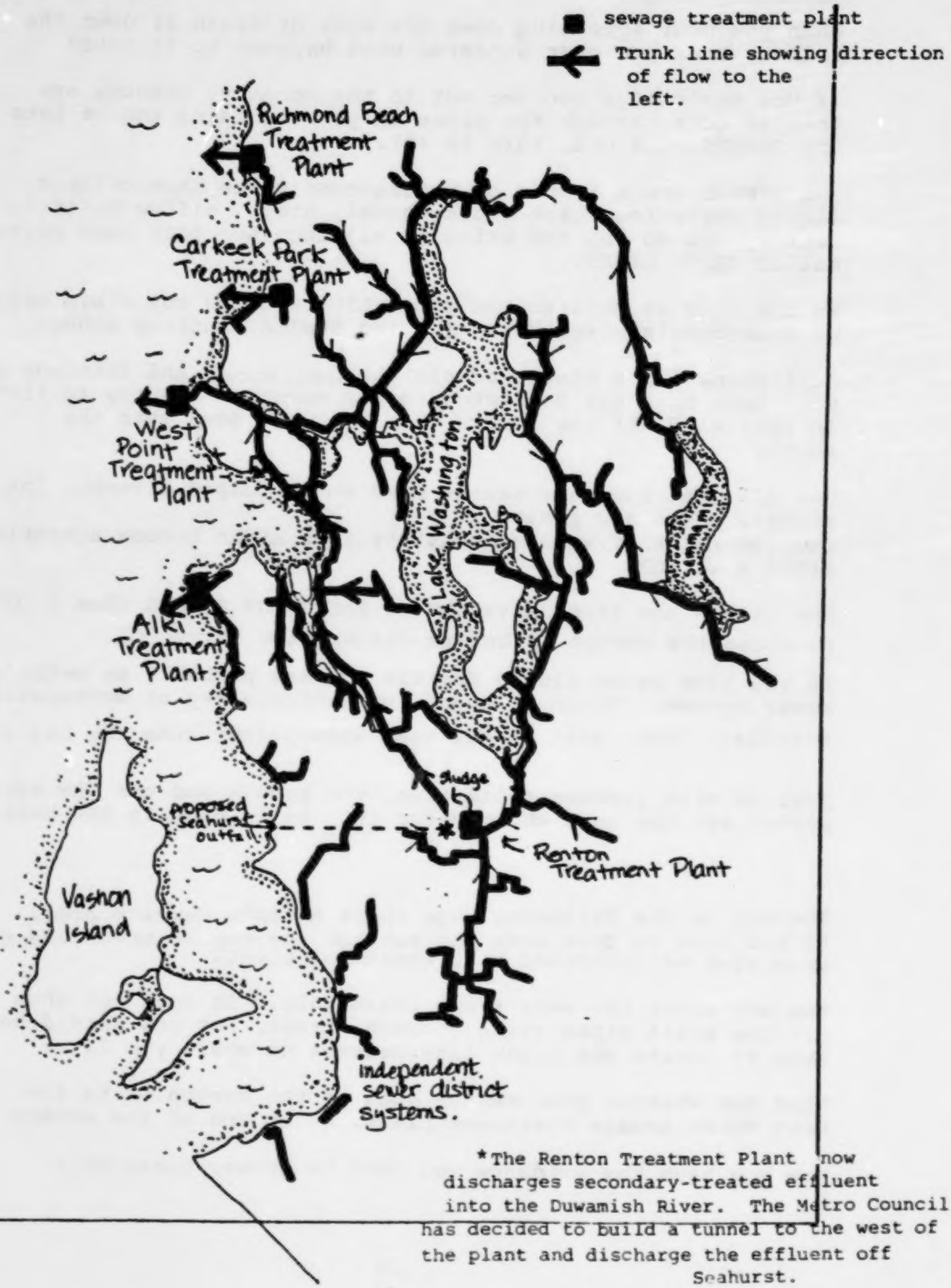
Find out whether your sewage goes to the Renton or to the West Point sewage treatment plant, or to one of the others.

Now you have the evidence you need to answer question 4.

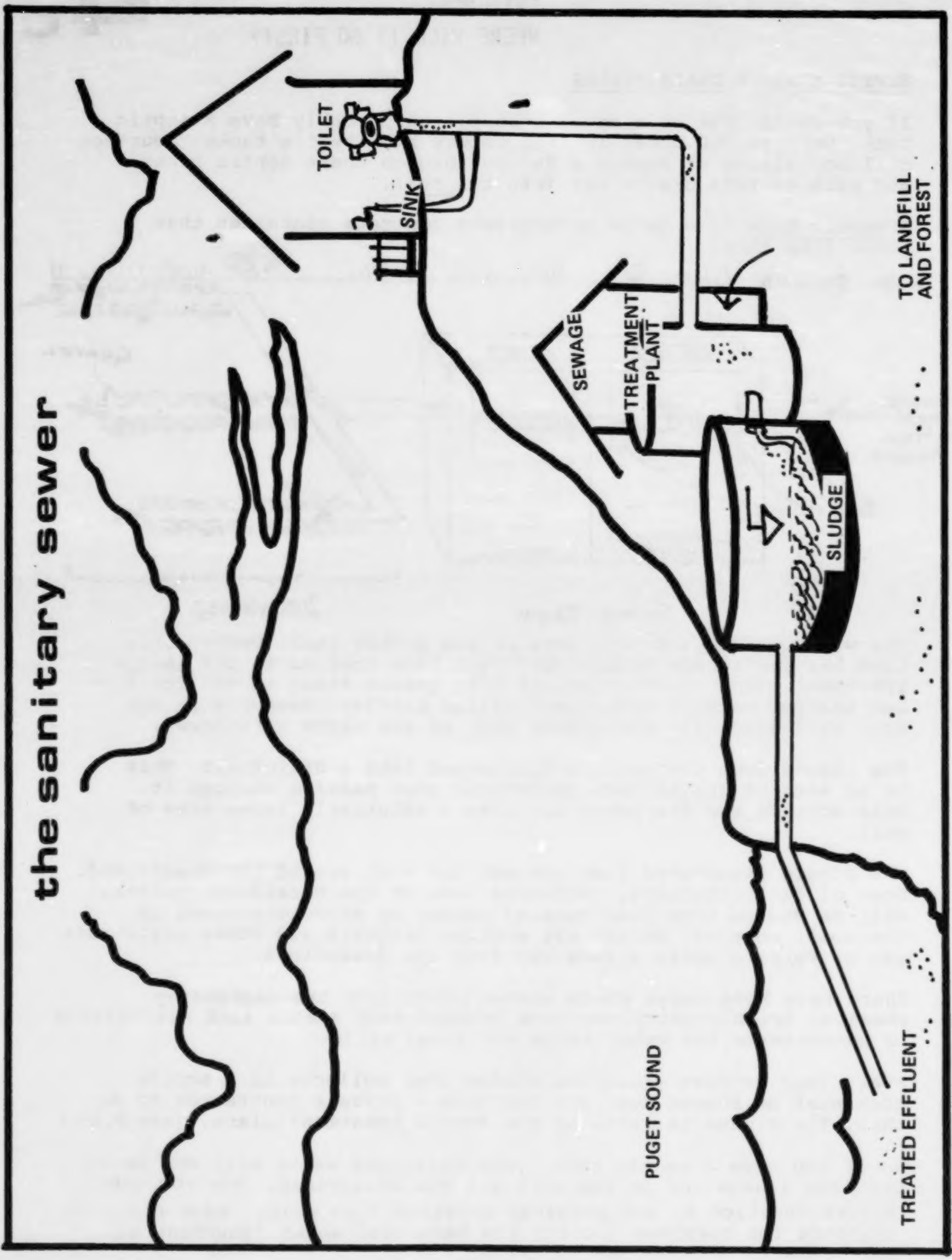
EVIDENCE:
WHERE WILL IT GO FIRST?

4b

SEWERAGE SYSTEMS (Metro)


■ sewage treatment plant
Trunk line showing direction of flow to the left.
Richmond Beach Treatment Plant
Carkeek Park Treatment Plant
West Point Treatment Plant
Alki Treatment Plant
Lake Washington
Sammamish
sludge
proposed Seahurst outfall
*
Renton Treatment Plant
Vashon Island
independent sewer district systems.

*The Renton Treatment Plant now discharges secondary-treated effluent into the Duwamish River. The Metro Council has decided to build a tunnel to the west of the plant and discharge the effluent off Seahurst.


the sanitary sewer
TOILET
SINK
SEWAGE
TREATMENT PLANT
SLUDGE
TO LANDFILL AND FOREST
PUGET SOUND
TREATED EFFLUENT

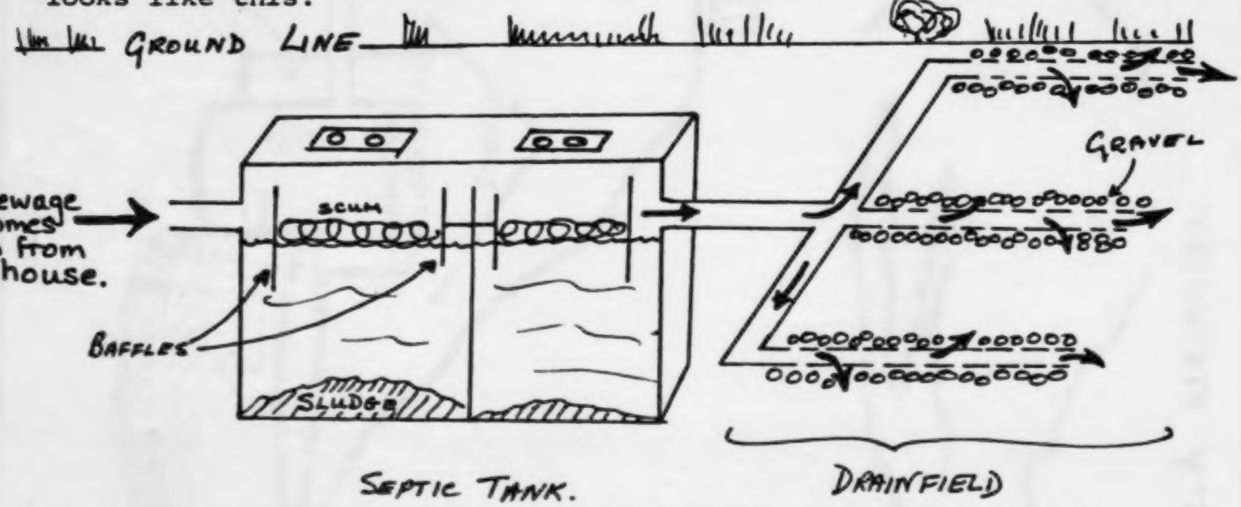
EVIDENCE:
WHERE WILL IT GO FIRST?

4c

SEPTIC TANKS & DRAIN FIELDS

If you don't live on a sewer system, you probably have a septic tank. Over 90,000 homes in King County have septic tanks. Fourteen million gallons of sewage a day go through these septic tanks, and much of this drains out into the soil.

A septic tank is a large underground concrete container that looks like this:



The wastewater spends 2-3 days in the septic tank. During this time heavier solids settle out, just like they do in the sewage treatment plant. Lighter solids like grease float to the top and are trapped between structures called baffles. Bacteria in the tank will gradually break down many of the waste substances.

The liquid from the tank is discharged into a drainfield. This is an area of gravel with perforated pipe passing through it. This spreads the discharge out into a relatively large area of soil.

The liquid percolates down through the soil around the drainfield. Some of the pollutants, including some of the hazardous wastes, will be chewed into less harmful pieces by micro-organisms in the soil. However, during wet months, bacteria and other pollutants can be carried quite a long way from the drainfield.

There have been cases where wastes containing the degreasing chemical trichloroethylene have leached from spetic tank drainfields to contaminate the water table and local wells.

Every four or five years the sludge that collects in a septic tank must be pumped out. You can hire a private contractor to do this. The sludge is taken to the Renton treatment plant. (See P.43.)

So if you have a septic tank, your hazardous waste will end up in the tank sludge, or in the soil via the drainfield. Now you can answer question 4, and probably question 7 as well. Save the evidence for question 7 until you have read about "Movement of Chemicals in Soil and Water" (P.44).

EVIDENCE:
WHERE WILL IT GO FIRST?

4d

WATERWAYS

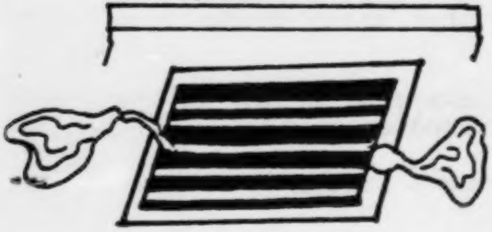
Did you pour it in the storm drain? In the ditch? In your backyard? In the driveway?

If so, your product has a good chance of getting into local waterways -- a stream, river, lake or even Puget Sound -- because you have put it into your watershed.

A watershed is the area of land which drains rainfall into a particular stream, river, or lake. Small watersheds or drainage basins are usually part of larger watersheds or drainage basins, your creek flows into a larger creek which flows into a lake or river and so on. For example, the Kelsey Creek drainage basin in Bellevue is part of the Lake Washington drainage basin or watershed which is part of the larger Cedar River Basin or watershed. (See Map 4d)

Now let's figure out where your product went in your watershed.

First, the storm drain. The square metal grates at the sides or curbs of streets are called storm drains or catch basins. When it begins to rain, the first drops soak into the ground, but once the soil is saturated, or if cement is in its place, the rain runs along the surface and is caught in these basins. They drain anything on your driveway, backyard or street into the storm sewer system.



Once there, these "runoff" waters enter pipes which carry them to larger pipes or "trunk lines" buried under the ground. These pipes then take the waters and empty them into the nearest waterway: a creek, river, lake, or Puget Sound.

Where do you live? Do you know the creek or lake nearest your house? If so, check to see if the name matches one of the watersheds on Map 4d and enter the evidence in the Question box. If not, obtain a "Guide to King County" map from King County Public Works, Room 900 King County Administration Building, Seattle, Wa. 98104 - or another map showing local streams - and determine your watershed. Remember that water flows down hill. You may have to search for the high point of land in your neighborhood to determine which of two watersheds is yours!

If you live in the City of Seattle, your task is more difficult. In some areas of Seattle such as Thornton Creek, Longfellow Creek, Carkeek Creek and Miller Creek, your storm sewers go to the creek. In other areas of the city, however, the storm drain pipe joins up with the sanitary sewer pipes and goes to Metro's sewage treatment plant at West Point. This is called a combined sewer system. Phone the City of Seattle Engineering Department (625-2317) if you do not know whether you're on a storm sewer system or a combined sewer. Enter your evidence for Question 4.

Next, the ditch or backyard. In some areas there are no storm drains. Once the soil is saturated, the rains run overland to the nearest ditch or gully and downhill towards the nearest waterway.

If you disposed of a product -- oil in a ditch or a pesticide in your backyard -- and it rained very hard the next day, that rain could send your waste one of two ways: overland along the ditches to a waterway, or down into the groundwater.

Groundwater, water table, aquifer, artesian well, springs -- all are names which describe where water is and what water does underground. What water does underground is very complex. The most important part of the watershed is that about which we usually know the least!

Simply put, water drains or soaks into the ground until it hits a layer of rock that is difficult to penetrate. The water then collects and flows in an area called an aquifer. Some aquifers drain their waters into a lake or stream, below the water line and out of our sight. Other aquifers are enclosed by the layers of rock around them and do not move. Many people drill wells into both kinds of aquifers, those that flow and those that are like pockets. Aquifers around the country are becoming contaminated at an alarming rate, and drinking water supplies are threatened. We all need more evidence about the nature of our aquifers and the routes that carry toxic or hazardous chemicals to them.

For the purposes of this sleuth, you need to be aware of three possibilities. The groundwater with your waste product may percolate:

1. down to an aquifer which empties into a stream or lake in your watershed, or
2. down to an aquifer which empties into a stream or lake in a neighboring watershed, or
3. down to an aquifer which is trapped.

(Liquid from your septic tank or the local landfill may do the same thing.)

Look at the diagram "Chemicals in the Water Cycle". (P.36)! Remember that everything in the water cycle is a chemical...including water.

The chemicals in your waste products will behave in different ways. Some may be carried far, others remain in the soil where you put them (see more on this in question #6). Some may be changed into other substances.

For the moment, decide where your chemicals might have gone if they were carried off in overland run-off or if they got into ground water. Put the name of your watershed or waterway in the box in QUESTION 4.

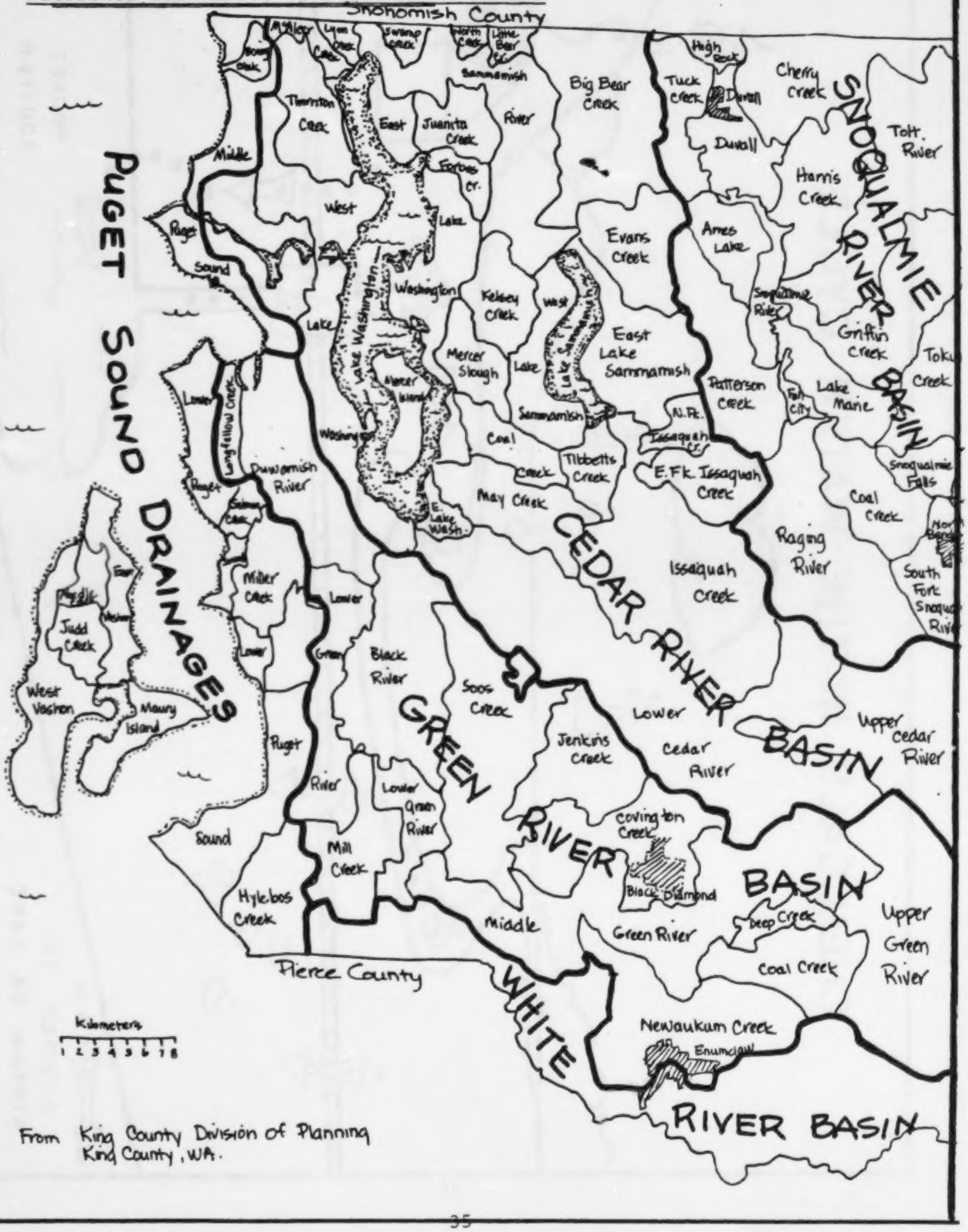
Save the rest of your evidence for QUESTION 7...which you have probably answered here.

MAP

Watershed Boundaries of Streams and Rivers

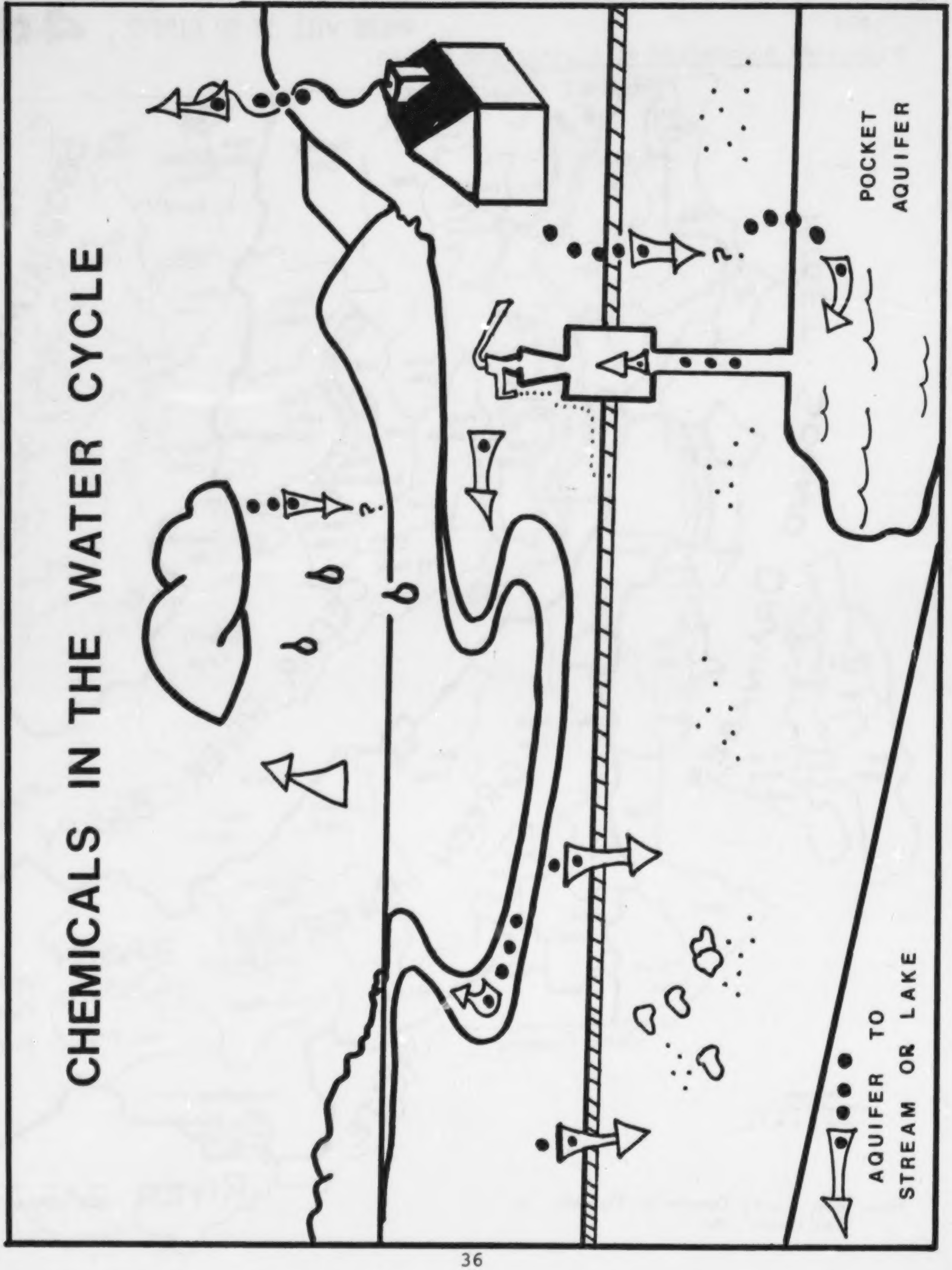
EVIDENCE:
WHERE WILL IT GO FIRST?

4d



From King County Division of Planning
King County, WA.

CHEMICALS IN THE WATER CYCLE



EVIDENCE:
AND NOW....DEPENDING ON ITS PHYSICAL CHARACTERISTICS....

5

The various PHYSICAL CHARACTERISTICS of a substance are important when you are considering where it will end up in the environment. Use this guide to help you identify the physical characteristics of your hazardous waste.

1. WHAT COLOR IS IT? *Look ________________

2. WHAT IS ITS PHYSICAL STATE? *Look
   - SOLID → HOW BIG ARE THE PARTICLES? *Look
     - LUMP
     - GRAINS
     - POWDER
   - LIQUID → HOW FAST WILL IT EVAPORATE? *
     - QUICKLY
     - SLOWLY
   - GAS

*Look at the label. Does it mention volatility? Are there any warnings about inhaling fumes? If so, the substance evaporates quickly.

*Open the lid and smell carefully (don't stick your nose right over the container!). If you can smell something the substance is evaporating.

3. IS IT SOLUBLE IN WATER? **
   - SOLUBLE
   - INSOLUBLE → HOW WILL IT BEHAVE IN WATER? **
     - FLOAT
     - MIX
     - SINK

**Look at the label. Does it mention solubility?

**Look at the directions for use. Do they mention mixing with water? Or does the substance obviously come into contact with water when you use it? (Like detergents, etc.)
If so you can test a small amount in a beaker of water to see what happens.
If not, don't test it. You'll have to leave this question blank.

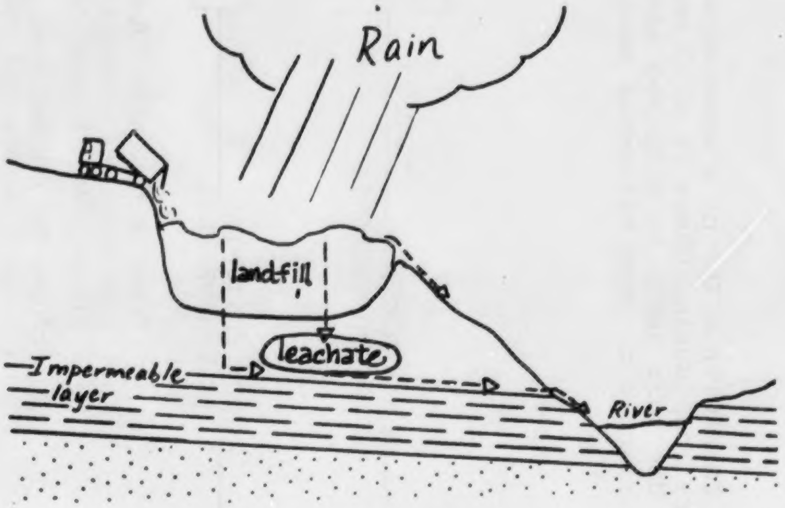
EVIDENCE:
.....AND WHERE YOU SENT IT..... 6a

LANDFILLS LEACHATE

Trash in landfills used to be burned to reduce the volume. This produced a relatively non-toxic ash, but sent a lot of very nasty substances into the air.

So they stopped burning the waste, and started compacting* and burying it. Now the problem is leachate.

> Pour hot water over coffee grounds. The first bit of water is absorbed. As the grounds get saturated, the water leaches through the grounds, and what you collect in your coffee pot is leachate. So leachate is partly water and partly the chemicals it has picked up on the way.



At the landfill it is the rainwater, and any liquids in the waste, that leach through. Soluble toxic or hazardous materials can be washed down with them. The leachate will go down through the soil until it reaches an impermeable layer (a layer it cannot go through), or it will flow down hill over the surface. Thus there is a potential for contamination of groundwater or waterways.

Agencies responsible for landfills are now having to deal with this problem.

At Cedar Hills a grid of perforated plastic pipes have been put in underneath the landfill. These collect the leachate and carry it to one of Metro's sewage treatment plants (See P.44) The Duvall landfill also has some perforated pipes and ditching which carry leachate to a holding tank. Here the leachate is pumped into a truck, and driven to a place where it can be pumped into the sewer system. The other King County landfills will have similar systems installed in the future. There is also a leachate collection system at Seattle's Kent Highlands landfill to pipe the leachate directly into sewers.

If you can decide whether your waste will leach or not, then you can answer question 7,

---

* The waste at a landfill is heavily compacted or crushed to 1600-2000 lbs/cu.yd. Compare this with the trash in your garbage can, which is compacted to about 175 lbs/cu.yd. Because of this compaction, almost any container will break open and its contents will be exposed to the leaching process.

EVIDENCE:
.....AND WHERE YOU SENT IT 6b

WASTEWATER (SEWAGE) TREATMENT

A sewage treatment plant, as we mentioned before, is a place where wastewater gets cleaned up before it is DISCHARGED (sent out) into the environment (receiving water).

Think back to the list that you made of all the waste that goes down to the sewers from the toilet, sink, bath-tub, washing-machine, etc. Treatment plants can also receive wastes from industries, cleaners, hospitals, restaurants, and other places.

Wastewater can contain a lot of BACTERIA. Fecal matter and the general environment are the source of these bacteria and wastewater provides a great place for them to grow. Since some of the bacteria in the wastewater make people sick, wastewater must be collected and treated before being discharged to the environment. Different bacteria are used to treat the wastewater. They chew up some of the toxic substances we have been talking about, and use them for their own energy.

Much of the waste in sewage is removed, or partly removed, by treatment before it is discharged. The wastewater is DILUTED with clean water to lessen its impact on the environment.

METRO has five treatment plants: Renton, Alki, Carkeek Park, Richmond Beach and West Point. You can find them on the "Sewerage System" map on page 30. The Renton plant discharges treated wastewater into the Duwamish River. The other plants discharge directly into Puget Sound.

Different environments have different abilities to handle wastewater effluent. Different types or levels of sewage treatment are used based on the amount of treatment necessary for the particular receiving waters.

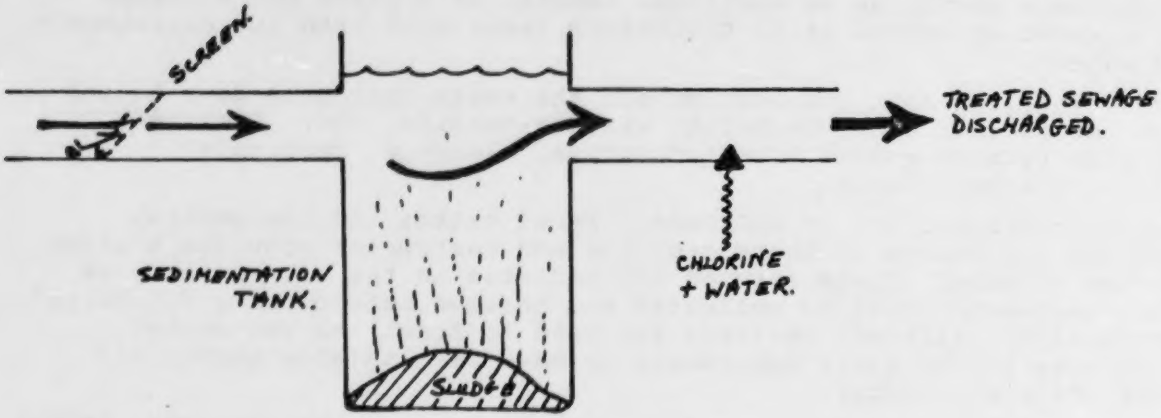
There are two types of pollutants that need to be cleaned out of sewage:
1) Such things as human excrement and food scraps, and their associated bacteria, which can cause serious human health and environmental problems when discharged in large quantities.
2) Hazardous chemical wastes which can cause serious damage to all kinds of organisms, although the effects may not be immediately apparent.

For some years now, we have recognized and understood the first problem, and have learned how to deal with it. This is why sewage treatment plants were originally built. And as far as these kinds of wastes are concerned, our lakes, rivers and beaches are cleaner and healthier today than they were in years past.

Today we are only starting to recognize and understand the second problem: potential environmental damage from hazardous wastes. There is no doubt that treatment removes or changes to a less harmful form, some of the toxic substances found in sewage. However, some toxic substances are not removed and are discharged into the Duwamish River and Puget Sound.

People at Metro and elsewhere are still working to identify whether the toxic substances which are discharged are a problem. If they are, we must figure out the most effective ways of dealing with them.

PRIMARY TREATMENT



The treatment plants that discharge into the Sound (West Point, Carkeek, Alki and Richmond Beach) all have primary treatment.

Primary treatment is a relatively simple process. First the sewage is screened to remove large items (pieces of wood, rocks, etc.) and then passed through a sedimentation tank where the solids and heavier particles settle out and materials that float are skimmed off.

The residue that settles out is called SLUDGE, and it collects such things as fecal matter, bacteria, food particles, toilet paper, toxic metals, and other solids. The wastewater spends 60-90 minutes in the sedimentation tank.

The liquid that comes out of the tank is then CHLORINATED, by bubbling a mixture of water and chlorine gas through it. This chlorination kills off almost all the bacteria.

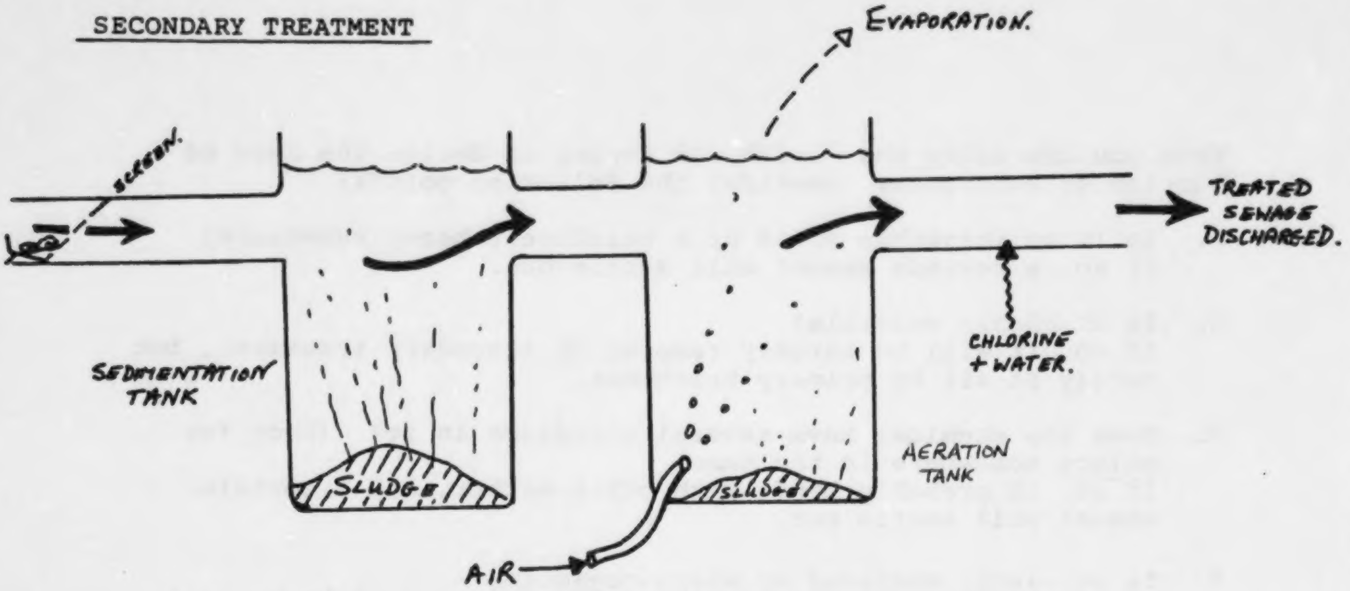
Primary treatment removes about 65% of the solids, 40% of the heavy metals, and 20-40% of other substances. Many hazardous wastes come into this category of "other substances". The degree to which they are removed varies from substance to substance.

Heavier substances will partly settle out, and partly continue through to the environment. Lighter substances will pass right through. The simpler solvents like acetone and methanol will pass through, although chlorinated solvents tend to bind with other matter and settle out in the sludge.

There is not much time for bacteria in the sedimentation tank to chew up substances in the liquid, although they work on the sludge solids.

Clearly the discharge is by no means pure water, but is is certainly cleaner than "raw" (untreated) sewage. Primary treatment is considered adequate for discharge to the deep marine waters of Puget Sound.

SECONDARY TREATMENT



The Renton treatment plant has secondary treatment.

Secondary treatment is a more complicated process that is also more effective--more things are removed.

The first stage is a sedimentation tank just like the primary treatment.

Next the partly cleaned sewage spends 6 hours in an AERATION TANK. This is simply an open tank through which air is bubbled -- just like the air that is bubbled through a fish tank. What this air does is to increase the oxygen content of the wastewater. The bacteria in the digester likes this extra oxygen so they reproduce and the population increases rapidly. Now this big crowd of bacteria gets to work on tiny pieces of material which passed through the primary process and on some of the toxic substances, and starts to break them up.

Another thing that happens when air is bubbled through is that volatile substances evaporate much faster than under ordinary conditions. Simple solvents, for example, are largely removed in this way.

The aerated wastewater then goes to a second sedimentation tank, where the bacteria, fine particles and many of the toxic chemicals settle out. Finally, the liquid is chlorinated to kill any remaining bacteria, and the treated sewage is discharged.

This secondary treatment at Renton removes 90-95% of the solids, 70% of the heavy metals and 80-100% of the other substances. This is much better than primary treatment, especially for many of our household hazardous wastes. But it is also much more expensive to build and operate than primary treatment.

When you are doing the Sleuth and trying to decide the fate of particular substances, consider the following points:

1. Is it an insoluble solid or a relatively heavy substance?
   If so, a certain amount will settle out.

2. Is it highly volatile?
   If so, it will be largely removed by secondary treatment, but hardly at all by primary treatment.

3. Does the chemical have several chlorines in it? (Look for chloro somewhere in the name)
   If so, it probably binds with other matter, and a certain amount will settle out.

4. Is it easily degraded by micro-organisms?
   If so it will be broken down to a certain extent by bacteria in the sewage. This degradation will be more extensive in secondary than in primary treatment.

5. Remember that some of the hazardous wastes are mixtures of several chemicals that may behave differently during sewage treatment. Consider them separately.

Do you have enough EVIDENCE now to answer question 7?

Will the waste end up in the sludge, in the ocean or in the air?

If you decide it will end up in the sludge, turn the page and see what happens to it next.

SLUDGE

You have followed your hazardous waste as far as the sludge in the sewage treatment plant. Now we have to see what happens to the sludge.

Because sludge contains lots of well-decomposed fecal matter, food particles and bacterial bodies, it is in some ways a kind of "super fertilizer". It seems that an ideal way to recycle these materials would be to use them on gardens, farmlands and other areas to fertilize the soil.

However, tests show that most sewage sludge also contains some toxic substances such as heavy metals and chlorinated solvents, which settle along with solids during the sewage treatment process. Some of these substances can accumulate and concentrate (see p. 52) in plants and animals to levels that may cause problems. For this reason, the EPA has special restrictions on the levels of toxicants in sludge that is used on farm or garden soils producing food-chain crops.

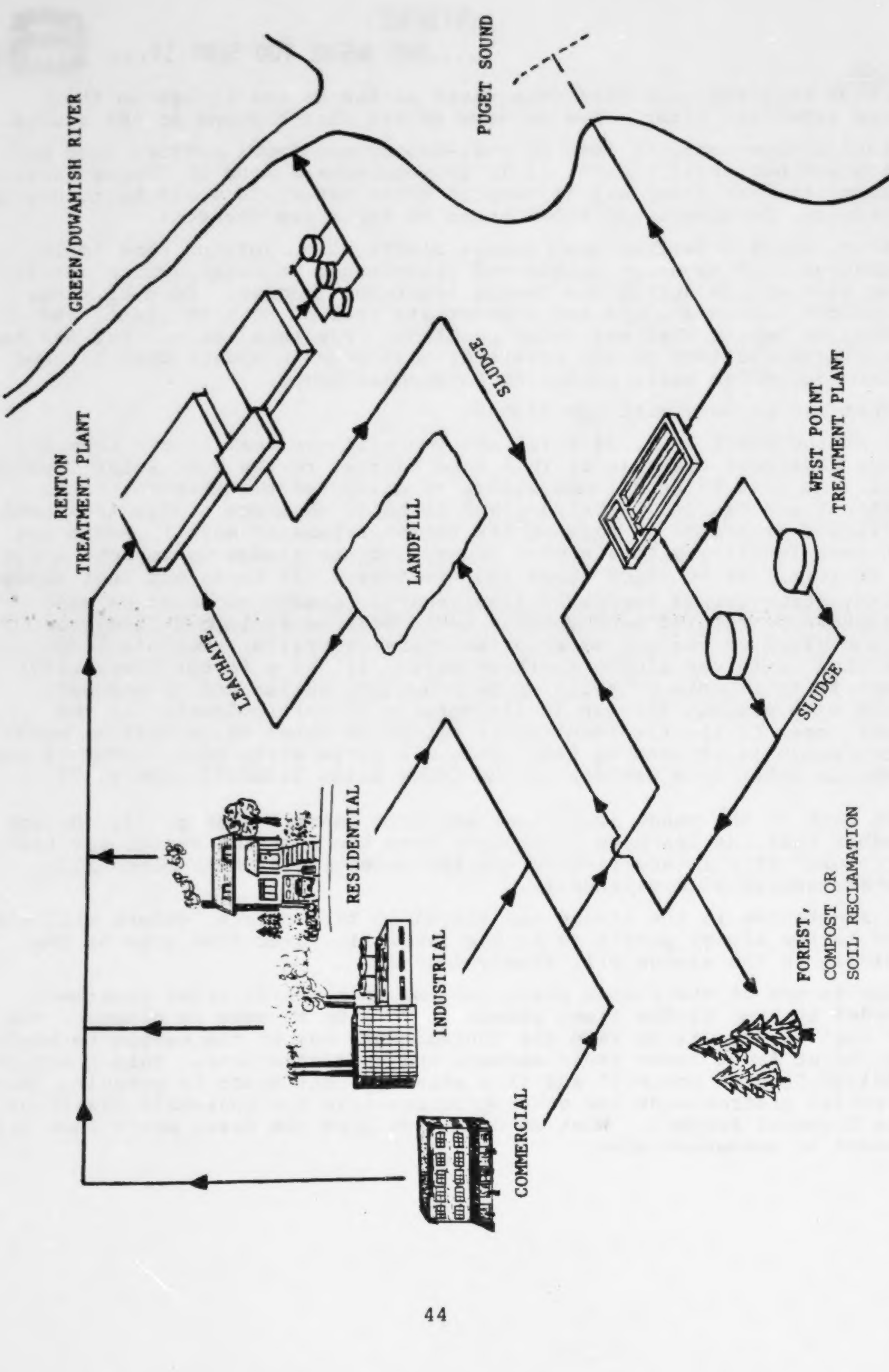
So what can be done with the sludge?

Look at the chart on p. 44 again and you will see that sludge from the Renton Treatment Plant is at this time carried to the West Point Treatment Plant. At West Point all the sludge is collected together for final treatment and disposal. (Metro plans to build separate sludge treatment facilities at Renton as part of the Renton expansion work.) Metro has been experimenting with a number of ways to use sludge to improve soils and to fertilize non-food crops such as trees. It turns out that sludge is very effective at improving tree growth. Sludge can also be used to improve or rebuild poor quality soils such as reclaimed land from surface mines or the top cover of sanitary landfills. Metro's long-term plan is to use sludge in three ways: 1) as a forest tree fertilizer; 2) to improve or build up poor quality soils; and 3) compost sludge with sawdust for use in landscaping or horticulture. At the moment, most of the treatment plant sludge is taken to Centralia, Washington, where it is used to help reclaim a large strip mine. Some of the sludge is taken to a section of the Cedar Hills landfill (see p. 27).

Think back to the sheet about leachate from landfills on p. 38. Do you remember that the leachate is brought into the sewerage system and treated at Renton? It's interesting to see the potential circle: landfill-leachate-sewage-sludge-landfill.

Some substances in the sludge may travel in this circle, others will stay bound to the sludge particles in the landfill. Over time some of the chemicals in the sludge will slowly degrade.

Sludge is one of the places where contaminants reside after treatment. In order to keep sludge clean enough to use, or to make it cleaner, the most logical step is to keep the contaminants out of the sewage to begin with, or at least lower their amounts and concentrations. This practice is called "source control" and is a strategy that Metro is pursuing through industrial pretreatment and other programs like the Household Hazardous Waste Disposal Project. What we don't put down the drain won't come back to haunt us somewhere else.


GREEN/DUWAMISH RIVER
PUGET SOUND
RENTON
TREATMENT PLANT
LANDFILL
LEACHATE
SLUDGE
WEST POINT
TREATMENT PLANT
SLUDGE
RESIDENTIAL
INDUSTRIAL
COMMERCIAL
FOREST,
COMPOST OR
SOIL RECLAMATION

EVIDENCE:
....AND WHERE YOU SENT IT... 6c

MOVEMENT OF CHEMICALS IN SOIL AND WATER

Much of the evidence that you have gathered to date should indicate that some of our household wastes end up in soil and water:

- -- in your backyard or driveway,
- -- in a stream or lake,
- -- around the drainfield of your septic tank,
- -- in the soil under a dump or landfill,
- -- in forest soils where sludge is used as fertilizer
- -- in Puget Sound via the sewage treatment system or storm drains
- -- in an aquifer.

Is it in the soil?

If it rains a lot, if the particles of soil are large with big spaces between the, and if the chemical is soluble, then the chemical will seep quickly into the ground.

If it is dry, if the particles of soil are small and close together, and if the chemical will not dissolve in water, then the chemical will seep slowly into the ground.

If the substance, or a piece of it, sticks to the soil, then it may not seep down. This process whereby a chemical sticks to particles of soil is called adsorption.

It is very difficult to find out whether your household waste will seep rapidly, seep slowly, or adsorb. You might ask a chemistry teacher to give you a few educated guesses for a start. (Read "Missing Evidence" on pages 18-21.)

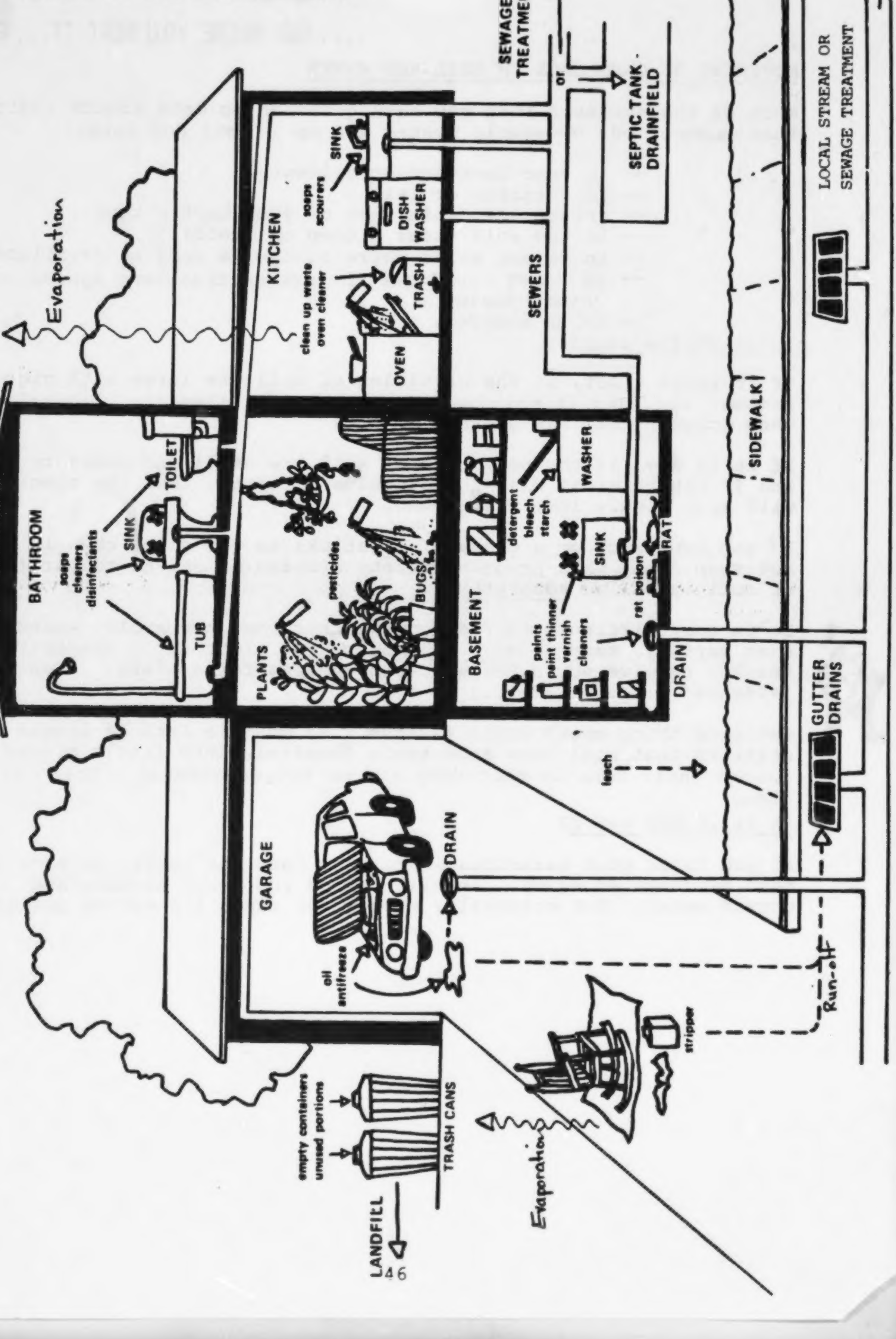
One good thing about soils is that they contain lots of little tiny critters that will chew some toxic chemicals into little pieces or change their form so that they are no longer harmful. They will degrade them.

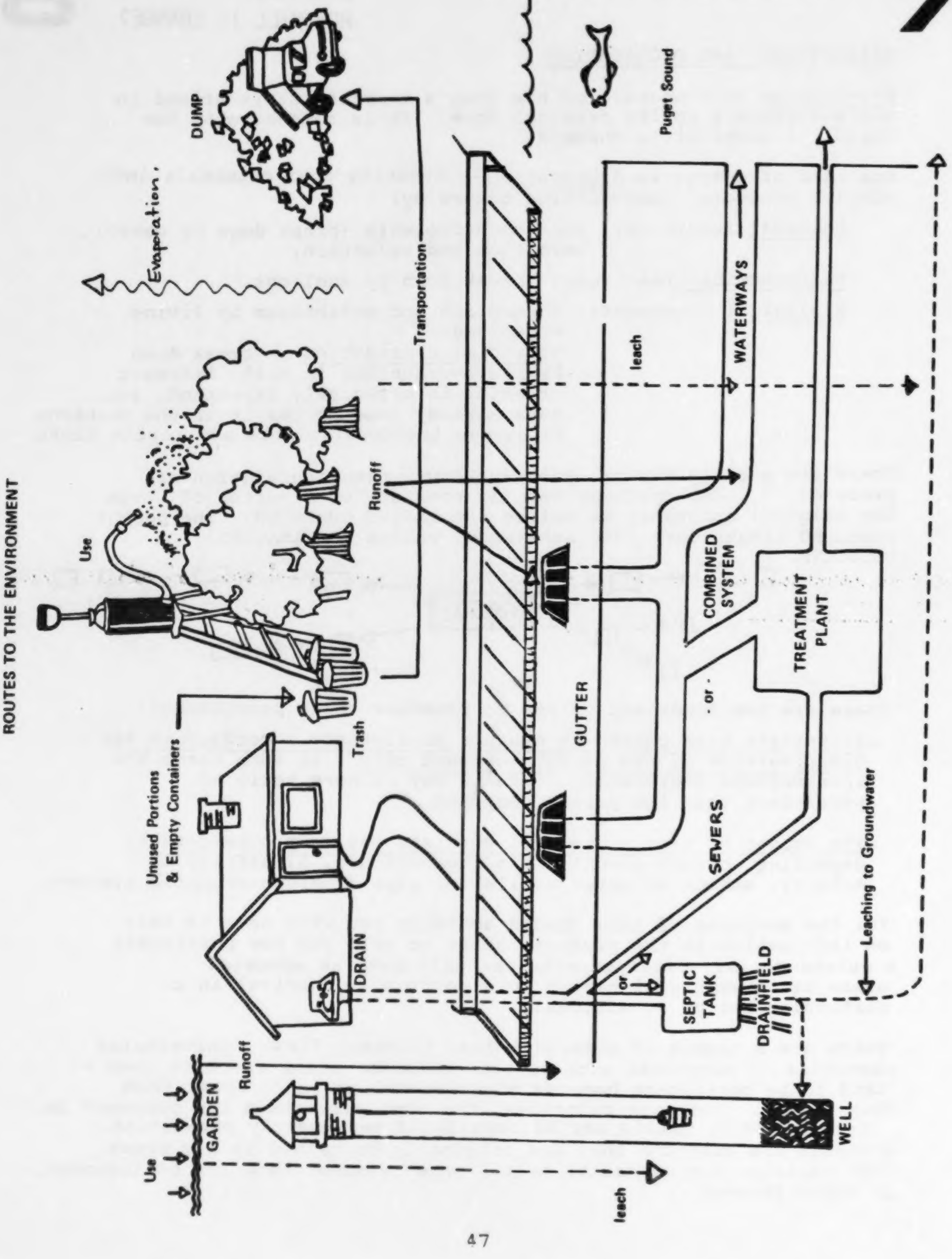
Is it in the water?

If you think your hazardous waste went into the water, go back and read evidence 4d again. It will remind you about streams and ground water. But eventually most water finds its way to our oceans.

7

Routes to the Environment I





ROUTES TO THE ENVIRONMENT

PERSISTENCE AND DEGRADATION

Persistence is a measure of how long a chemical stays around in the environment in its original form. It is a measure of how rapidly a chemical is changed.

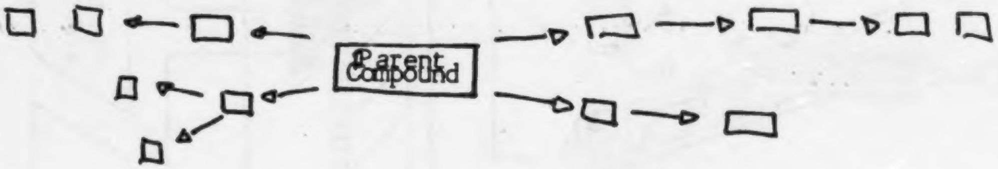
One kind of change is degradation -- breaking down chemicals into simpler products. Degradation occurs by:

Chemical reactions: such as hydrolysis (break down by water), oxidation and reduction.

Photochemical reactions: break down by sunlight.

Biological processes: absorption and metabolism by living organisms. Microbial degradation -- break down by micro-organisms in soil, sediment or water is especially important. You have already come across it in the sections on sewage treatment plants and septic tanks.

There are usually several pathways down which degradation can proceed. Each pathway usually consists of a series of steps. The original substance is called the PARENT COMPOUND. The parent compound breaks down into substances called DEGRADATION. PRODUCTS.



There are two important points to remember about persistence:

- Scientists have chosen to measure persistence according to the disappearance of the parent compound only. In some cases the intermediate degradation products may be more toxic or persistent than the parent compound.
- The amount of time a chemical persists may vary considerably depending on such conditions as temperature, alkalinity or acidity, amount of water available, type of micro-organism present.

For the purposes of this Sleuth activity you will have to rely on information in the product tables to tell you how persistent a substance is. Often experts can only make an educated guess as to what will happen to a particular chemical in a particular set of conditions.

There are a couple of general rules, however. First, chlorinated chemicals -- compounds with several chlorine atoms stuck to them - tend to be persistent because micro-organisms can't break them down easily. The more chlorines, the more persistent the compound is. Second, heavy metals may be considered permanently persistent. Although the compound they are originally contained in may break down rapidly, the elemental metal, once released into the environment, is there forever.

PERSISTENCE AND ACCUMULATION

HOW TO CALCULATE HALF-LIFE.

For some substances persistence can be measured by the half-life. The half-life is the amount of time it takes one half of a chemical present to disappear.

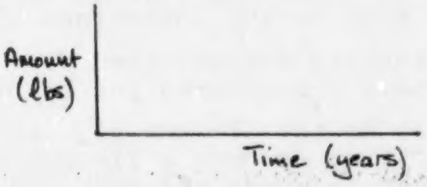
Take 10lbs. of a chemical with a half-life of one year. How much of it will be left after 1 year? (5lbs.)

Now how much of this 5lbs. will be left after another year?

You may be tempted to say NONE. But that's not right. Look at the definition of half-life again. You have 5lbs. of a chemical with a half-life of 1 year, so after 1 more year you will have 2½lbs. left.

How much of this 2½lbs. will be left after yet another year?

Draw a graph to illustrate these answers.



HOW TO CALCULATE ACCUMULATION.

When a chemical is added to the environment faster than it can be degraded, then it will gradually ACCUMULATE.

You are going to spray a pesticide on your 2 acre field. You use one with a half-life of 1 year, and you spray at a concentration of 5lb/acre.

How much will have accumulated after 4 years if you spray every year?

And if you spray every 2 years?

How much will have accumulated after 2 years if you use a pesticide with a half-life of 6 months (½ year) at the same rate of 5lbs/acre?

To do these problems you have to calculate the residues left from each application, and then add them up.

Again draw graphs and note any differences between them.

FOLLOW UP.

Look at the numbers and the graph from the problem on half-life. What can you say about the rate of disappearance of substances whose persistence can be measured according to their half-life?

Is a chemical with a long half-life more or less persistent than one with a short half-life?

What connection is there between half-life and rate of accumulation?

HOW DO TOXICANTS GET INSIDE ANIMALS AND PLANTS? 10

There are a number of ways for a toxic substance to pass through a living organism.

In animals, this happens in one of three ways:

1) By eating or drinking contaminated food or water. This route is called ingestion.

   The toxin has entered the gastro-intestinal tract, sometimes referred to as the G.I. tract.

   Some substances that are ingested remain in the G.I. tract and are passed out in the feces.

   Others pass from the stomach via the bloodstream (either unchanged or partly broken down) to the liver. The liver is a special organ that can change many substances into a form that is more easily excreted.

   From the liver, substances either pass again into the bloodstream or back to the intestines via the bile.

2) By breathing contaminated air. This route is called inhalation. The toxin has entered the respiratory system.

   Fish do not breathe air, and they have no respiratory system. But they do have gills which provide a route or entry from the water in which the fish are swimming.

   Substances entering through the lungs or the gills pass directly into the circulatory system.

3) Through contact with the skin. This is dermal exposure.

   Substances absorbed through the skin may also pass into the circulatory system. The circulatory system carries toxins or their degradation products around the body. Many are removed from the blood by the kidneys and then pass out in the urine.

Toxins and degradation products can also be passed from the blood to the lungs and excreted through exhalation. Or they can be excreted through the skin with perspiration.

Some toxins may be carried to cells where they can be stored, such as bone cells or fat cells.

In plants this happens in two ways:

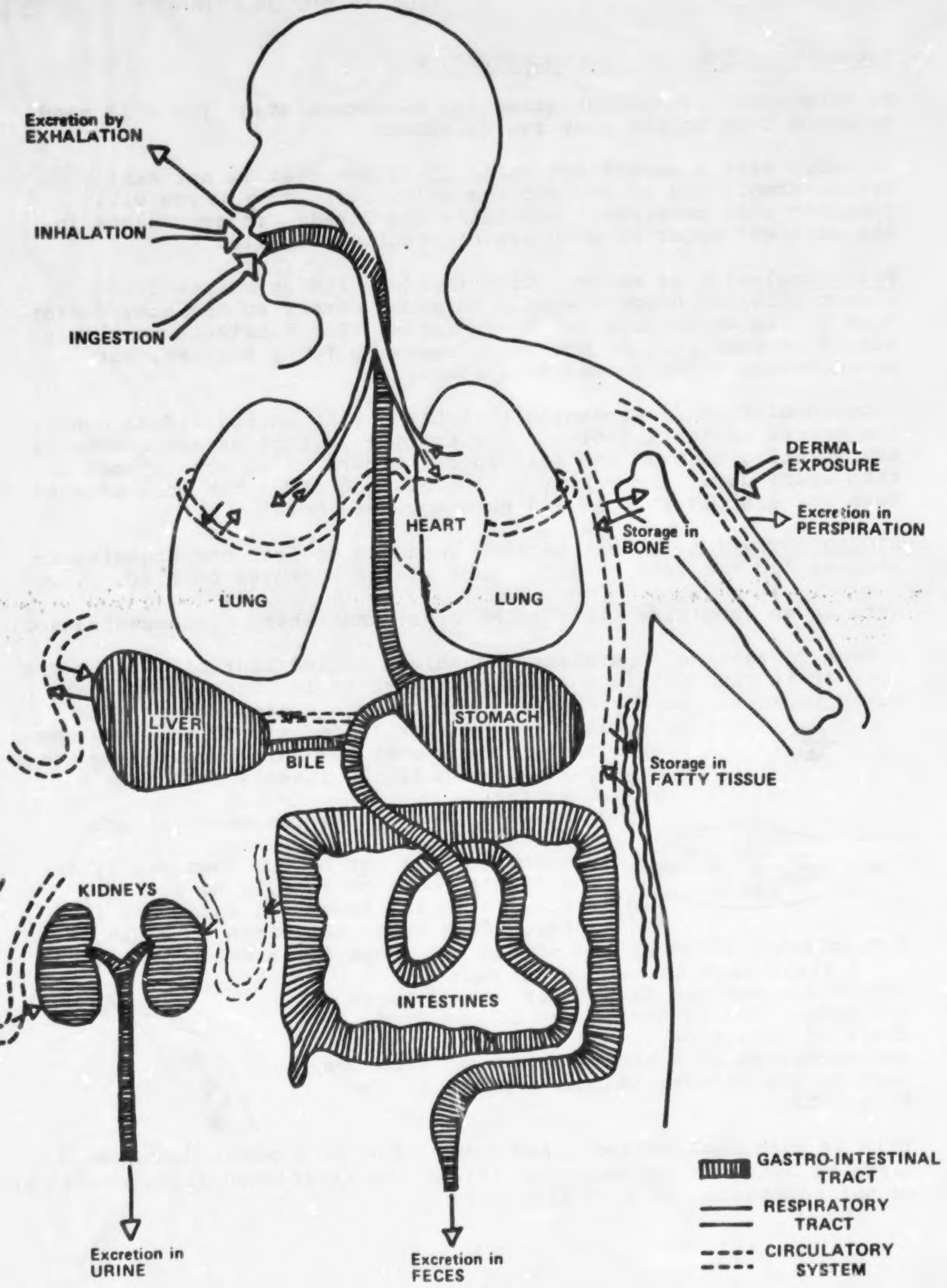
1) By absorption through the roots for toxins that are in solution in the soil. These substances can be translocated to the stem, leaves and fruits.

2) By absorption through the leaves for toxins that fall out from the air. Depending on its chemical nature, a toxic substance may or may not translocate to other parts of the plant.

Return to the Sleuth and mark the possibilities which might occur from your disposal product. See Missing Evidence. (pages 18-21).

10

EVIDENCE: HOW IS IT ABSORBED, DISTRIBUTED, ELIMINATED?



EVIDENCE:
WILL IT BIOCONCENTRATE?

12

BIOACCUMULATION AND BIOCONCENTRATION

To understand bioconcentration and bioaccumulation you will need to think back to the last two questions.

Remember that a persistent chemical is one that is not easily broken-down. And if you did the calculation on p.49 you will remember that persistent chemicals are likely to accumulate in the soil and water if they are constantly reapplied.

Bioaccumulation is accumulation inside a living creature. Bioaccumulation happens when a chemical enters an organism faster than it can be metabolized or excreted. The substance is simply stored in some part of the body - usually fatty tissues, but occasionally other places like bones.

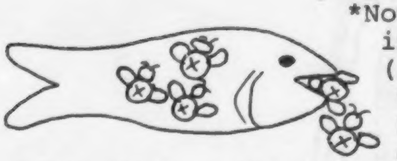
Bioaccumulation is something that happens to an individual over the course of its lifetime. For example, all of us are gradually accumulating cadmium and lead in our bodies as we are exposed to them every day. Your body will contain quite a bit more of them when you are old than it did when you were born.

BIOCONCENTRATION is what happens when you go from one organism to another "up the food chain". Look at the pictures on P.50.

Here is an imaginary story to help you understand bioconcentration.

A drum containing a persistent chemical called Xantobil leaks and some of it runs off into a stream. Here it is absorbed by small water insects. No big deal for the insects - each one of them only has a tiny amount (1 "part") of the substance inside them, and it does not harm them. Along comes a hungry fish. Ten little insects will make a good breakfast.

*Now how many "parts" of the chemical are inside the fish? (Remember, it is not broken down easily in the fish's body, so it will be stored.) Perhaps even the fish will suffer no ill effects from these ten parts of Xantobil .



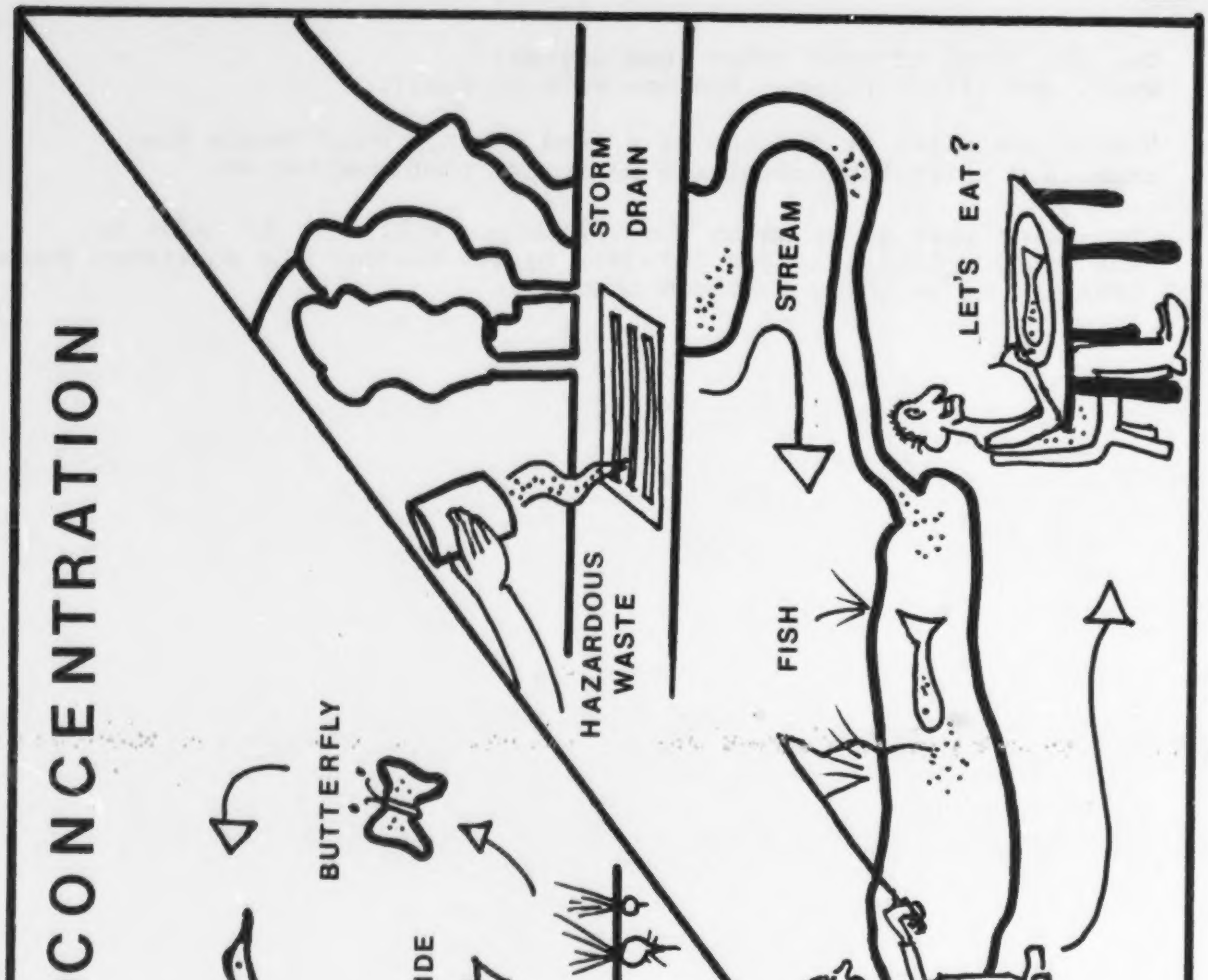
A Kingfisher flies by the stream and stops for a meal. She eats three fish, each containing 10 parts of Xantobil. Now the Kingfisher has 30 parts in her body. She is at the top of the food chain in this story. And you can see how the concentration of Xantobil increased from one part in the insects to thirty parts in the Kingfisher.

This is bioconcentration. And now we are in trouble, because 30 parts of Xantobil may make our friend the Kingfisher sick, cause her to not reproduce, or even kill her.

Can you think of some other food chains?
Start one with a plant. End one with yourself.

Humans are often at the top of a food chain. Which means that chemicals which bioconcentrate may cause problems for us.

To answer this question on the Sleuth you will have to refer to the Product Tables (pages 139-147) to see whether the substance you are considering is going to bioconcentrate.


BIOCONCENTRATION
CAT
BIRD
PESTICIDE
BUTTERFLY
GARDEN
HAZARDOUS WASTE
STORM DRAIN
STREAM
FISH
FISHERMAN
LET'S EAT ?

WHAT IS A TOXIC SUBSTANCE?

Acute means sudden or immediate.
Chronic means long-term.

These two words are used in two ways when talking about toxicity. We can speak of acute or chronic exposure and acute or chronic effects.

Exposure:

Acute exposure is a single or very brief exposure; a one-time event.

Chronic exposure is repeated exposure over a long period of time.

Both acute and chronic effects depend on how poisonous--toxic--the substance is, and what the dose is. And, in the case of chronic toxicity, the frequency of exposure is also important.

Acute effects are the ill effects that occur immediately after exposure to too much of a toxic substance. For example, getting jittery after you drink coffee or soda pop with caffeine is an acute attack.

Chronic effects are the ill effects that do not appear immediately but do appear after a period of time. Chronic effects often occur at doses too small to produce acute effects. A single acute exposure to some substances in early pregnancy may produce a baby with a birth effect, which is a chronic effect. On the other hand, repeated cigarette smoking (chronic exposure) might not lead to the development of lung cancer (a chronic effect) until many years after the person started smoking.

There are many kinds of chronic effects. Some of the most common are:

- Liver or kidney damage: Organs that are primarily concerned with breaking down and getting rid of toxic substances in the body are damaged.
- Central Nervous System (CNS) Damage: Damage to the CNS (nerve cells in the brain and spinal cord) can be exhibited in minor ways, such as depression or slight changes in I.Q., or can consist of serious damage, such as paralysis.
- Cancer: A cancerous cell is one that starts to multiply and doesn't know when to stop. Eventually a tumor will grow and spread. A cancer-causing chemical is called a carcinogen.
- Birth defects: Birth defects can be caused in two ways:

  A substance which changes the baby as it is developing inside its mother is called a teratogen. Only pregnant women are subject to the effects of teratogens.

  Chemicals which cause mutations are called mutagens. A mutation is a change in a cell which alters some characteristics of the organism. If the mutation is in the sperm or egg cell which makes a baby, this change will be passed on to the baby, and to the baby's children.

MEASURING ACUTE TOXICITY

This table shows one way in which different toxic substances can be rated.

Toxicity rating	Fatal dose (mg/kg)	Probable oral lethal dose for a 150 lb. (70 kg.) human
SUPER TOXIC	less than 5	a taste (less than 7 drops)
EXTREMELY TOXIC	5-50	7 drops - 1 teaspoon
VERY TOXIC	50-500	1 teaspoon - 1 ounce
MODERATELY TOXIC	500-5000	1 ounce - 1 pint (or pound)
SLIGHTLY TOXIC	5000-15000	1 pint - 1 quart
NON-TOXIC	more than 15000	more than 1 quart.

(From Gosselin et al.(1976) Clinical Toxicology of Commercial Products.)

Dose means how much you take - just like you take a particular dose of medicine, a teaspoonful, or two teaspoonfuls.

One way that scientists measure dose is in mg/kg. This means the number of milligrams (mg) per kilogram (kg) of body weight.

QUESTION: If you receive a dose of 5mg/kg, and you weigh 30kg. (66lbs.), how many total mg. did you actually receive?

And if you weigh ½kg. (1lb.)

The third column in the table above translates the scientific measurement of fatal (deadly) dose into actual amounts that would kill a 150lb. human.

You will often find concentrations of toxic substances (either in the soil, water or in the body) expressed in terms of ppm. This stands for parts per million.

If you say the concentration of oil in the river is 10ppm, you mean that out of a total of a million "parts" of water, ten of them are oil.

The "parts" can vary according to what is most convenient - grams, liters, teaspoons.

QUESTION: How many ppm is 1 mg/kg?
(1000mg = 1g; 1000g = 1kg.)

ppb means parts per billion; 1000 ppb equals 1 ppm.

EVIDENCE:
COULD IT CAUSE IMMEDIATE
OR LONG-TERM HARM?

13c

CALCULATING ACUTE TOXICITY

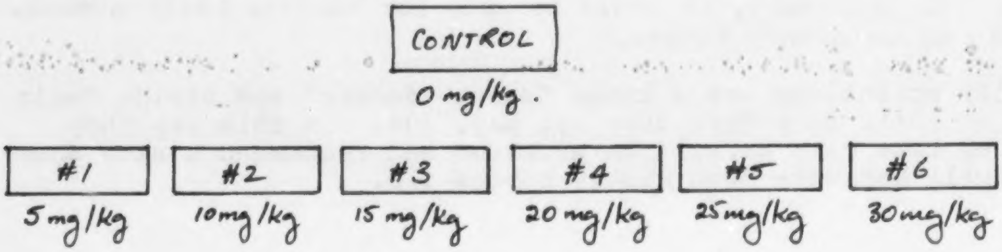
Pretend you are a chemist who has discovered a way to make a new chemical that could be used for preserving meat.

Before you are allowed to sell it to meat packing manufacturers, you have to find out whether it is toxic. Of course you can't feed it to people to see if they get sick or die, so what do you do??? You feed it to rats!

Rats are mammals, like humans, so we assume that their bodies respond to poisons in the same way ours do. This is often, though not always, true.

Here's how you will test the substance for acute toxicity.

Let's say you have 7 cages with 6 rats in each. You are going to test 7 different doses of your new chemical by feeding each cage of rats with a different dose in their lunch. The group that receives a zero dose is the CONTROL group.



At the end of the day you look in the cages to see how many of the rats have died, and this is what you find:

Control...........0 dead

Cage #1...........0 dead

Cage #2...........1 dead

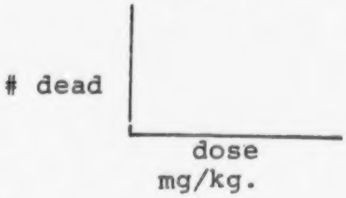
Cage #3...........3 dead

Cage #4..........5 dead

Cage #5..........6 dead

Cage #6..........6 dead

Draw a graph to illustrate your findings.



What conclusions can you draw about the acute toxicity of the chemical you have just tested?

What do you think the control group is for?

LD_{50}

Scientists must do many kinds of tests for any new drugs, pesticides or food additives that are developed.

The degree of toxicity is often expressed in terms of the LD_{50}. This stands for Lethal Dose - 50%, which means the dose at which 50% (½) of the test animals die.

What was the LD_{50} of the meat preserving chemical in the above test? (15 mg/kg)

Calculate how much of it would kill a 70kg. (150lb) human.
Calculate how much of it would kill a 10kg. (22lb) human.

But how does all this help you decide how much of your chemical you can put in a serving of meat?

Check the graph again. Is there a dose that doesn't kill any rats?
Why not use this dose?
(Because 1. - a poison can make you sick at a much lower dose than it would kill you, and 2. this dose is for healthy adult rats - so presumably it would be safe for healthy adult humans. Plenty of us aren't either.)

Usually scientists use a large "safety factor" and divide their LD_{50} or their no effect dose by, say, 100. In this way they hope to take care of all the problems and recommend a safe dose that will not make even sickly babies ill.

13d

FIGURING OUT CHRONIC TOXICITY

Now that you have figured out the acute toxicity of your meat preservative, you need to know the chronic toxicity.

Again you have 7 cages with 6 rats in each. And again you will test each group with a different dose, including a control. This time, however, you will give each group a small dose every day for 2 years.

Control	#1	#2	#3	#4	#5	#6
0 mg	0.5 mg/kg	1 mg/kg	1.5 mg/kg	2 mg/kg	2.5 mg/kg	3.0 mg/kg

During the two year period, you will observe the rats and keep careful records. You will watch for signs of strange behavior or sickness. If any rats die, you will perform an autopsy to determine the cause of death and to look for such things as organ damage or tumors.

At the end of the two years, you will kill any of the rats that have not yet died and perform an autopsy on them.

Let's say that the meat perservative you are testing causes cancerous liver tumors, but apparently no other damage. These are your findings at the end of 2 years.

Cage #	Number of rats having liver tumors	Number of rats in cage dying before 2 years were over
Control	1	0
#1	0	0
#2	1	0
#3	2	0
#4	3	1
#5	6	2
#6	5	1

What are your conclusions?

Again, you could extrapolate to humans and use a safety margin to come up with a supposedly safe dose to put in your meat. Or can you?

Many scientists believe that a substance that causes cancer has the potential to do so in some members of the population, no matter how small the dose.

Cancers often take 20 years to develop in humans, and no animal tests are ever done for 20 years. It is assumed that relatively high chronic doses over a short period of time (2 years) will have the same effect as much lower doses over a much longer period of time.

The ways the laws are now for food additives, and in particular the Delaney Clause (see Laws and Regulations, pp. 116)you would not be allowed to use your meat preservative at any level.

However, if the chemical you developed were a pesticide or a solvent and you got these results from your testing, its use at a certain low concentration would be acceptable.

SLEUTH CONCLUSION

You may have found that it is illegal to dispose of your product in the ways that you would normally choose - the convenient ones. Or, you may have found that you not satisfied with the usual disposal methods, even if they are legal. What then?

A lot of people in the community are wondering about these same questions. Metro set up a Household Hazardous Waste Committee for 1981-82 to address the problems faced by householders who want to dispose of wastes responsibly. The committee had a very difficult time deciding what to tell members of the community. These are the recommendations that the committee has come up with:

Automobile products: waste oil, brake and transmission fluids can be taken to full-service gas stations to be recycled (call 1-800-RECYCLE). Batteries can be taken to be recycled and reused at a local battery shop. Contaminated gasoline can go to Northwest Tank (622-1090). What should happen to clean gasoline and antifreeze?

Pesticides: Excess or unwanted pesticides can go to one of four Seattle/King County Health Department sites (see map). Empty containers can go in the trash after they've been triple rinsed. Where should the rinse water go?

Paints: Excess or waste paint could be used by someone. Call METRO (447-5885) for the name of a community group that needs paint. Or maybe a neighbor could use it. What should happen to the paint cans?

Solvents: Solvents can be used up--again, call METRO for a source. Or they can go to a solvent reprocessing company (see yellow pages under Waste Disposal).

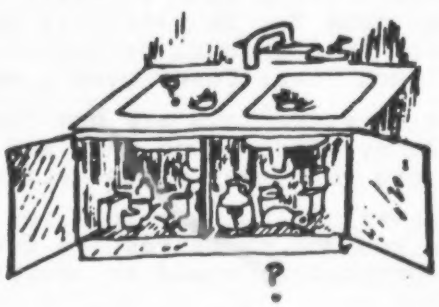
Household Cleaners: Usually there isn't any waste or excess product because they get used. What should be done if there's some extra cleaner?

Each of these alternatives has some benefits and disadvantages.

Other alternatives could be considered: a once a month dump day? a county dump for household hazardous products? requiring stores, manufacturers to provide for disposal? These will all require lobbying on your part.

Do the DISPOSAL OPTION/TRADEOFF SHEETS as a means of deciding the best strategies.

Notice that "using up" these substances usually means putting them into the environment in one form or another. Cleaners go down the drain into Puget Sound, solvents and aerosols go into the air, pesticides go into the soil, and sometimes the water. What can be done about these use problems?



DISPOSAL OPTIONS/TRADEOFFS

AUTOMOTIVE PRODUCTS

Your car leaves you with oil, antifreeze, brake & transmission fluids to dispose of.

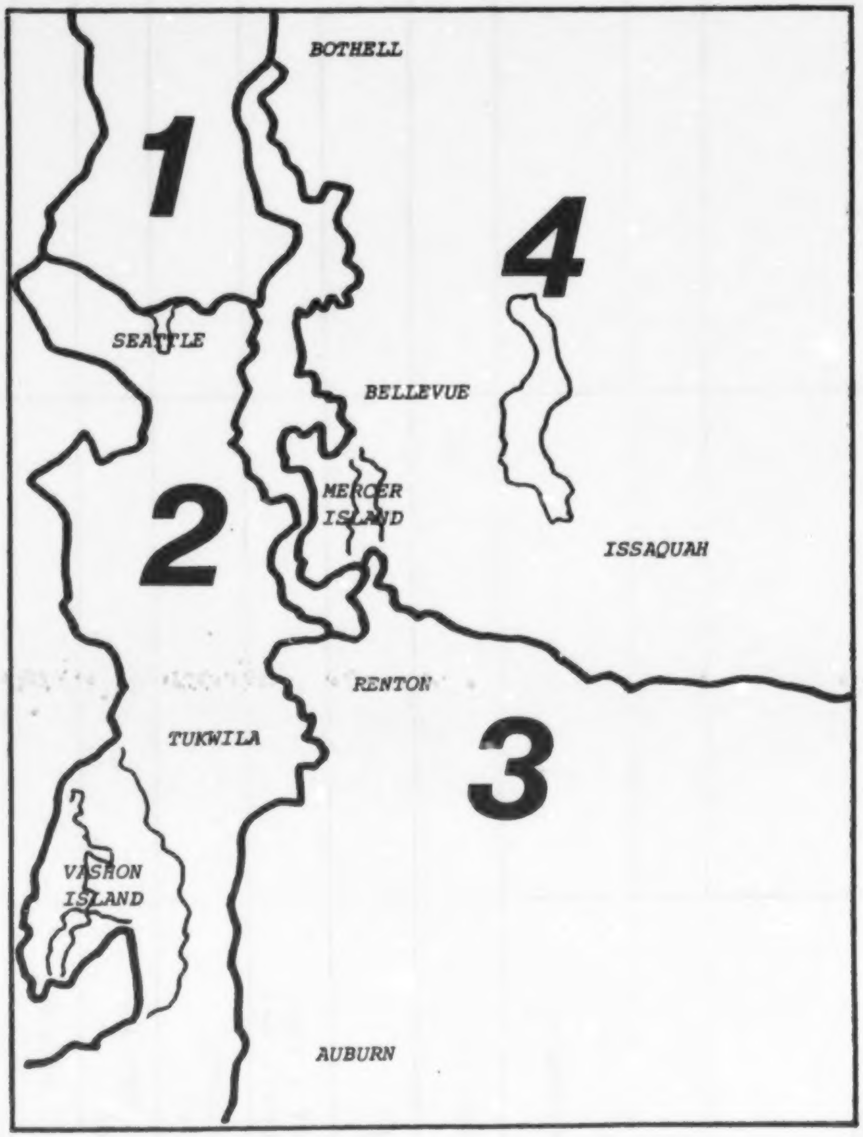
	Tradeoffs	
Usual Disposal Methods	Benefits/Advantages	Risks/Disadvantages
storm drain garbage can pour on dirt or bury it		
Alternatives		
Recycle oil, brake & transmission fluids at a gas station that will take them		
Use less (drive less)		
County could establish a small hazardous waste dump for household quantities		
Lobby for all gas stations to take waste products from cars		
Lobby to have county establish a dump day every month		

DISPOSAL OPTIONS/TRADEOFFS

PESTICIDES

Usual Disposal Methods (of containers as well as excess quantities)	Tradeoffs	
	Benefits/Advantages	Risks/Disadvantages
garbage can bury in ground incinerate/burn landfill pour it in the backyard		
Alternatives		
Ban the sale or use of pesticides in Seattle/King County.		
Use less		
Take to Health Dept. (blue pages)		
Take to company that disposes of hazardous wastes (yellow pages)		
County could establish a hazardous waste dump for household quantities		
Share excess with a neighbor		
Require manufacturer to provide directions for disposal		
Require stores which sell pesticides to provide place for disposal		
Require manufacturer to give more information on the biological effects of the pesticide		
Garden without pesticides		

TO DISPOSE OF YOUR OLD PESTICIDES, CONTACT THE HEALTH DEPARTMENT OFFICE FOR YOUR AREA:



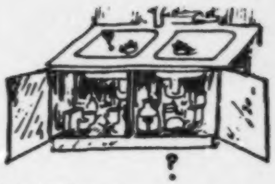
AREA 1:	CALL	363-4765	(NORTH SEATTLE)
AREA 2:	CALL	625-2125	(DOWNTOWN SEATTLE)
AREA 3:	CALL	228-2620	(RENTON)
AREA 4:	CALL	885-1278	(BELLEVUE)

SEATTLE-KING COUNTY
DEPARTMENT OF PUBLIC HEALTH

A community service of the Seattle-King County Department of Public Health, made possible by Amalgamated Services & Chemical Processors, Inc. donating their time. This is an outgrowth of Metro's Household Hazardous Waste Committee.

DISPOSAL OPTIONS/TRADEOFFS

HOUSEHOLD CLEANERS



Cleaning your house leaves you with aerosol cans to dispose of and other wastes

Tradeoffs

Usual Disposal Methods for Household Cleaners	Benefits/Advantages	Risks/Disadvantages
drain (through use⇒wastewater) garbage can (containers) air Alternatives		
Use less		
Alternative cleaning practices: Use baking soda for scrubbing ovens, stoves, etc.		
Use weak bleach solution to disinfect		
Use soap and water for general cleaning		
Use furniture polish of 1 tsp. lemon oil in 1 pt. mineral oil		
Lobby the county for a dump for household quantities		
Lobby manufacturers to provide directions for disposal		
Stores provide disposal places		
Lobby for more specific information as to contents so you can make a choice of what to buy.		

DISPOSAL OPTIONS/TRADEOFFS

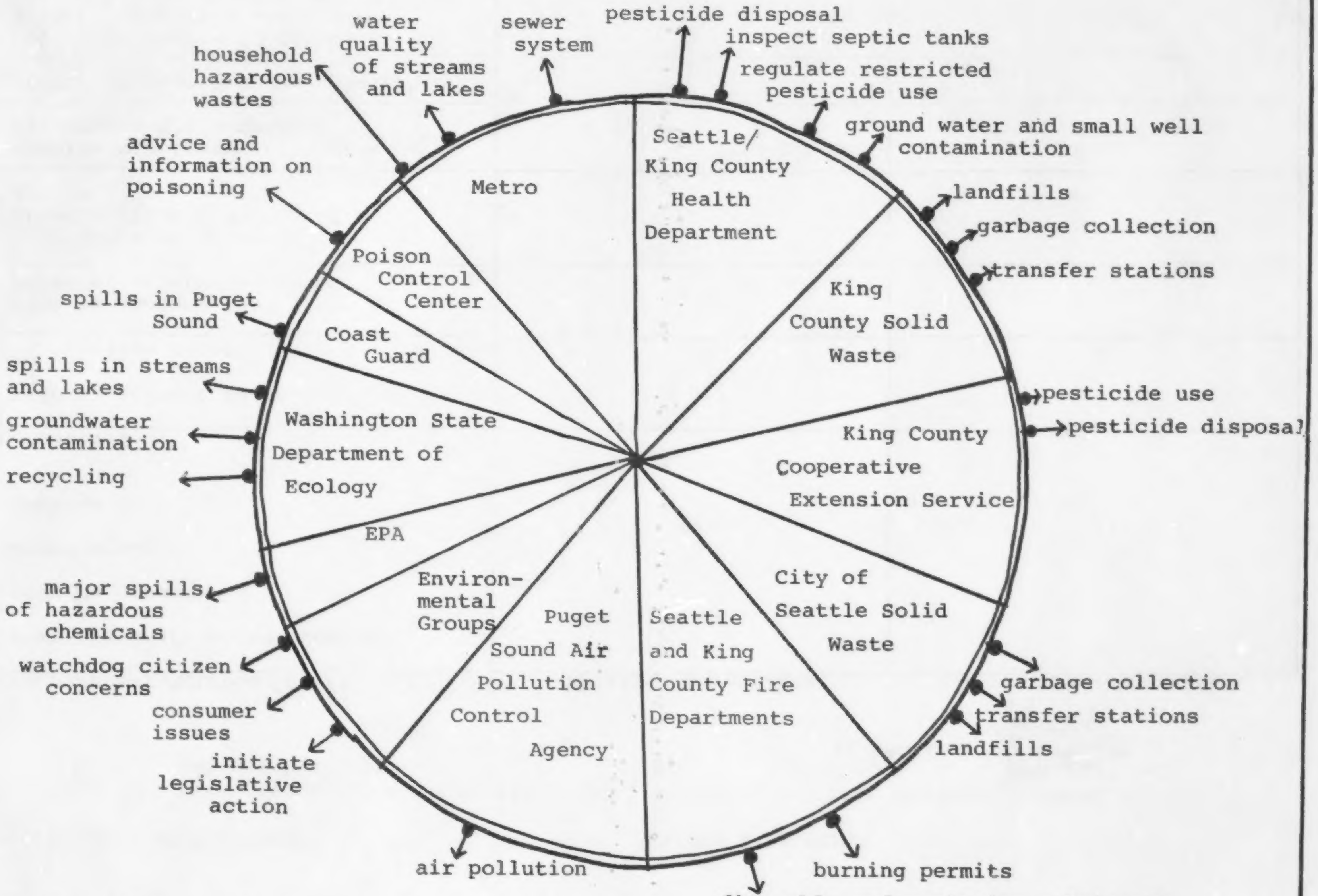
PAINTS & SOLVENTS

Household tasks leave you with excess paints, solvents to clean brushes, lacquer and paint thinners, and paint strippers.

Tradeoffs

Usual Disposal Methods for Paint Products.	Benefits/Advantages	Risks/Disadvantages
down the drain in wastewater pour on ground storm drain garbage can Alternatives		
Take to solvent recycling (yellow pages)		
Take to company that disposes of hazardous wastes		
Recycle paint to needy organizations and theater groups		
Require manufacturer to provide directions for disposal		
Stores provide disposal places		
Lobby the county to establish a small hazardous waste dump for household quantities		
Lobby the county to have a dump day once a month		

WHO IS RESPONSIBLE?


Seattle/ King County Health Department
pesticide disposal
inspect septic tanks
regulate restricted pesticide use
ground water and small well contamination
King County Solid Waste
landfills
garbage collection
transfer stations
King County Cooperative Extension Service
pesticide use
pesticide disposal
City of Seattle Solid Waste
garbage collection
transfer stations
landfills
Seattle and King County Fire Departments
burning permits
flammable and explosive substances
Puget Sound Air Pollution Control Agency
air pollution
Environmental Groups
initiate legislative action
consumer issues
watchdog citizen concerns
EPA
major spills of hazardous chemicals
Washington State Department of Ecology
recycling
groundwater contamination
spills in streams and lakes
Coast Guard
spills in Puget Sound
Poison Control Center
advice and information on poisoning
Metro
household hazardous wastes
water quality of streams and lakes
sewer system

Use the Telephone Directory to locate
phone numbers for these agencies....
(Try the Blue Pages)

section II

PROBLEM SOLVING AND ROLE PLAY

This Section includes three PROBLEM SOLVING EXERCISES (pp 69-72) where students can come together in small informal groups of 9 people, each with some specific information to contribute to an issue at hand. Please refer to the directions on the next page.

The ROLE PLAY (p. 73-87) requires more familiarity with the issues and problems of household hazardous waste and should be undertaken after other areas of the curriculum unit have been explored. Some research on the part of adventuresome students could increase the value of the activity. Four possibilities are suggested, ranging from easy to more difficult. Opportunities for the rest of a class to participate in the decision making process or the problem definition are indicated.

The GAME DISPOSAL (p. 89-97) is very flexible as to familiarity required--the more the student knows, the more confident they can be in making the right decision. It should take about 1/2 hour to play Disposal. There are no right and wrong answers in this game--only personal choices, which thereby reflect the "real world". If students have done the Sleuth and other activities, they should be adequately prepared to use the choices in the game as a meaningful learning activity. However, for teachers who may use the game as their primary mode of instruction for this topic, we have included a TEACHER'S KEY: GENERAL COMMENTS (p. 149), DISPOSAL CARDS (p. 153) and CARD NUMBER NOTES (p. 153).

There are three exercises:

Scenario #1: Hilda discovers a can of gasoline in her garage. What should she do with it? If she decides to dispose of it, what options does she have?

Scenario #2: A group of neighbors are setting up a community gardening project. They have purchased the plot of ground and are meeting now to make some decisions about policy. The first issue they decide to tackle is whether to use SLUG BAIT in their garden.

Scenario #3: Nine individuals who have had independent cleaning services have decided to combine their talents to create the "Zippy Cleaning Service". As a group they need to make some decisions about the products they will use and the policies they will follow.

The class may break into small groups, each working on the same problem and comparing notes at the end of a given time period. Or, they may work on different problems and draw conclusions at the end. These three exercises, with time for discussion and analysis, should not take more than a single class time period.

As the groups deliberate, they should keep track of their discussion on the DECISION SHEET. It would be interesting to compare how different groups arrived at a consensus as well as what they considered and the tradeoffs involved.

Students should understand that these are current issues. Current because in the last few years we have just begun to fully recognize the danger if we do not exercise caution in our use and disposal of chemicals. Issues, because there are many positions people can take; we simply don't know the effects of many chemicals; household quantities are generally small and may be insignificant; all household disposal options have some degree of risk if the chemical is toxic or severely persistent; alternatives to disposal and use raise the usual controversies over private sector and public sector - including those about who's responsible and who pays.

There is not necessarily one answer to these problems. Metro's Household Hazardous Waste Disposal Committee has just spent one year discussing disposal options for these three products; old gasoline, pesticides, and household cleaners.

WE'VE NEVER BEEN HERE BEFORE AND WE CAN ALL CONTRIBUTE TO SOLUTIONS . . . . .

PROBLEM SOLVING EXERCISES **Decision Sheet**

Which Scenario?________________________

Students in this group:____

____

After each person contributes information and the entire problem unfolds, what do you see as the ISSUES in this exercise?

What are your POSSIBLE SOLUTIONS?	What would be the TRADEOFFS for that solution?	What environmental or human health EFFECTS do you see from that solution?

FINAL DECISION:

Was the entire group satisfied with that decision? If not, why not?

Note any COMMENTS and QUESTIONS that your group had during your decision making process. Discuss with the rest of the class.

PROBLEM SOLVING EXERCISES: Scenario #1: Hilda's can of gasoline

Scenario #1
You are Hilda's neighbor, Nancy Nextdoor. You point out that gasoline evaporates. Maybe Hilda could just evaporate the gasoline. But you know that the fumes are dangerous--poisonous, in fact. There are small children in the neighborhood. You wonder, too, if evaporation might cause some air pollution.

Scenario #1
You are Lt. John Jones of the local fire department. It is very dangerous to store gasoline as it is a fire hazard.

Scenario #1
You are Hilda's brother-in-law, Fred. You tell Hilda that gasoline is an effective weed killer. Hilda has a large patch of blackberries in the corner of her lot. Maybe she should throw the gasoline on the ground around the berries.

UT → → → → →

Scenario #1
You are Joe Cleandrain from Metro. You can tell Hilda that it is against Metro regulations to pour gasoline down the drain of her sink.

Scenario #1
You are Pat, a neighbor of Hilda's. You know that gasoline is a solvent. How could Hilda use a solvent? You suggest Hilda might check with a recycling center that takes solvents. But the one you know of is 25 miles away--clear over on the other side of town.

Scenario #1
You are Chris, Hilda's high school son's buddy. You say that your dad has always poured his excess gas down the storm drain or catch basin in front of the house. It is in such small quantities, it can't possibly hurt anything.

:UT → → → → → →

Scenario #1
You are Peter Putrescible, a representative of King County Solid Waste. You tell Hilda that the transfer stations will not accept flammable materials.

Scenario #1
You are Hilda. You discovered a can of gasoline in your garage while you were cleaning. You don't know exactly how long it has been there. You worry that it may have water or oil or rust in it. You won't try to use it in your car for that reason.

Scenario #1
You are Hilda's son, Ralph. Another friend of yours says that his dad is glad when he has excess gasoline around. He uses it to start the barbeque.

↑ ↑ ↑ ↑ ↑ ↑ CUT

↑ ↑ ↑ ↑ ↑ ↑ CUT

PROBLEM SOLVING EXERCISES: Scenario #2: The Community Garden

Scenario #2
You are Bob Tool. You own the Valley Hardware and Garden Store. You know that Metaldehyde is the active ingredient in slug baits. It was first discovered in 1936 and has been around for a long time.

Scenario #2
You are Sally Street. You have used salt on the slugs in your own garden. Last year you used saucers of beer to get rid of them. The saucers had to be changed often though. Sometimes it seemed like a lot of work.

Scenario #2
You are Sandy Beach. You read in a gardening magazine that kelp or seaweed laid around the edges of the garden would get slugs. They crawl over the salty surface of the seaweed and the salt makes them dry up.

CUT → → → → →

Scenario #2
You are Polly Puregard. You checked with the local "Grow Em" Community Garden people. They don't allow any chemicals in their community gardens. If this garden project allows chemicals, you don't want to participate.

Scenario #2
You are Ned Punchly. You suggest that boards be put flat around the individual beds. The slugs would crawl under them in the day time and someone could turn the boards over and collect or kill them. Or maybe the group could elect a member to go out at night with a flashlight and collect them.

Scenario #2
You are Susan Feathers. You recommend that the group build a fence around the garden plot...and then another fence 2 or 3 feet away from the first. This would make a "run" for ducks and geese that the project would put in there. They should take care of the slugs before they get into the garden.

CUT → → → → → →

Scenario #2
You are Rita Byeby. You recommend planting sacrificial rows of bok choy, or lettuce, or cabbage, or whatever, all around the perimeter of the garden. That way the slugs will be too busy to get inside the "real" garden.

CUT ↑ ↑ ↑ ↑ ↑ ↑

Scenario #2
You are Dudley Doread. You brought a label from a slug bait container & know that:

- it is toxic to pets. Some pets have been poisoned by accidentally eating it in the garden. You also have to keep it away from the edible parts of the vegetables. What does that mean?

CUT ↑ ↑ ↑ ↑ ↑

Scenario #2
You are Johnny Goodgardner. You have tried very hard over the years to garden with a minimum of chemical pesticides or fertilizers. But you lost most of your lettuce last year to the slugs and that was a real pain. You also want the project to work out well and want everyone to feel comfortable with group decisions.

PROBLEM SOLVING EXERCISES: Scenario #3: The Zippy Cleaning Service

Scenario #3

You are very concerned about cleaners that come in aerosol containers. You know they are very popular but not very cost efficient. Small droplets can be dispersed throughout a room besides on the item being cleaned. Some propellants may cause environmental damage to the ozone layer around the earth. Also, disposal of aerosol cans is a problem. Cans can explode if they get too warm.

Annie Aerosol

Scenario #3

You have been looking into the amounts of hydrocarbons, petroleum distillates, and naphthas in polishes and cleaners. They can cause skin irritation and rashes, as well as eye, nose, throat & lung irritation. They are also hazardous if ingested--results in entry to lungs. Repeated exposure can cause liver and kidney damage.

Priscilla Polish

Scenario #3

You have researched some alternative cleaners. For general surface cleaning one recommendation was several tablespoons of vinegar in water. Supposedly good for glass or marble. Baking soda is supposed to be good for other areas that are particularly greasy--i.e., coffee pots, chrome, copper, and tile.

Granny Smith

CUT → → → → →

Scenario #3

You are concerned about disinfectants and deodorizers whose use constitutes disposal down drains or into the air. You know they do not create a germ-free environment anyway. You wonder about toilet bowl cleansers. They are disposed into the sewer. Does that create a problem?

Tom Smellnice

Scenario #3

You are concerned about alkalies found in dishwater detergent, some oven cleaners, and as lye in drain cleaners. Some phosphate laundry detergents contain some alkali. If swallowed, it could cause severe stomach pain and burns along the mouth & throat. If inhaled, causes severe coughing, can burn throat & lungs. Skin contact can cause burns. Eye contact causes burns, possible loss of cornea.

Carl Caustic

Scenario #3

You have researched an alternative to manufactured disinfectants:

1/4 cup bleach in

1 qt water

Bob Bleach

CUT → → → → → →

Scenario #3

You are concerned about the phosphates in detergents and TSP--a cleanser. You heard that phosphates can threaten lakes, rivers, and streams by encouraging algae growth.

Jack Cleanwater

CUT ↑ ↑ ↑ ↑ ↑ ↑

Scenario #3

You are concerned with the human health hazards of chlorine. It is the base of some bleaches and drain cleaners. Chlorine can cause burns and surface damage to eyes. If mixed with an acid, chlorine gas is produced. It is highly toxic & can cause death. If mixed with ammonia, chlorine gas is produced. It is toxic. Especially dangerous to those who have lung problems.

Cloris Toxgas

CUT ↑ ↑ ↑ ↑ ↑

Scenario #3

You have researched some alternatives to commercial furniture polishes:

1 teaspoon lemon oil
1 pint mineral oil

or

equal parts of:
turpentine
boiled linseed oil
vinegar
+ few drops of lemon oil for fragance.

Lisa Lemon

As a result of the concern of individual citizens, groups, and agencies responsible for disposal of quantities of household hazardous wastes. a Community Advisory Committee has been established. A representative from each of the following agencies or groups will form this committee of eleven people.

1. A company that accepts industrial and individual hazardous wastes to dispose of at a hazardous waste dump for a fee. (ie: Arlington, Oregon)
2. Environmental Protection Agency
3. King County Cooperative Extension Service
4. King County Solid Waste
5. League of Women Voters
6. Metro
7. Seattle/King County Health Department
8. Washington State Department of Ecology
9. A conservation activist group, such as Sierra Club, Friends of the Earth, Audubon, etc.
10. Washington Public Interest Research Group (WashPIRG)
11. King County Fire Department

Select a role to play on this committee. Familiarize yourself with the information on the ROLE PLAY COMMITTEE sheet for your role. These sheets indicate your areas of information, laws and regulations, if any, you are responsible to administer, and your concerns on this committee. Additional Information can be gained from research and review of materials in this unit.

You will be responsible for deciding how that person would respond to the issues or questions that arise in the role play activities.

Here are FOUR POSSIBILITIES for role play activities. (You may add more of your own, of course.)

1. As a committee, develop recommendations for disposal of excess household quantities of antifreeze and the pesticide Systox. Resource: Fact Sheet on antifreeze and Systox
2. You want to find out what people in your community think about household hazardous waste. Present options by which you could obtain this information. (ie. questionnaires,

phone surveys, door to door surveys, public meetings, mailed questionnaires, selected interviews, etc. etc.) Argue for or against each option, select the best one, and lay out how the committee would carry it out.

3. Assuming you and the class have worked through most of the unit activities, have the class members choose particular disposal problems and approach the committee for their recommendations. What would each of you suggest to the individual? Are there solutions to each disposal problem? What do you do when there aren't any clear answers?

4. You have worked through the unit activities and are familiar with the problems and issues involved with household hazardous wastes and their disposal. Consider the unanswered questions from the SLEUTH and the PROBLEM SOLVING EXERCISES. As a committee, you are charged with recommending to the League of Women Voters the courses of action that should be taken by your community, a larger municipality, or the state, in the next five years on the problems of the disposal of household hazardous wastes and maybe hazardous wastes in general.

   In this role play, members of the class could assume the positions of interested or involved parties and address the committee with their concerns. For example: pesticide manufacturers, hardware store chains, paint manufacturers, chemical manufacturers, etc. List their questions and concerns. Resource: The entire unit, especially the Big Picture Section.

ANTIFREEZE:

Contains ethylene glycol; 2-3% borate, phosphate, silicate as rust inhibitors.

Environmental hazards: poisonous to pets, fish and wildlife. Acquatic LC_{50} = 100-1,000 ppm.

Used antifreeze is contaminated by heavy metals from engine blocks.

Dumping in storm drains or bodies of water is illegal under Federal Law (Clean Water Act)

Toxicity listed at 0.5-5 gm/kg. LD_{50} for humans listed at 100 ml.

There are no efforts currently to recycle or reprocess antifreeze.

Effects of antifreeze in septic tank systems are unknown.

Also check: Product Tables, Automotive Products.

SYSTOX (DEMETON)

SYSTOX is a pesticide used on fruits, vegetables, and ornamentals.

Its purpose is to kill insects, especially aphids.

The chemical class is organophosphate. (Contains phosphorus)

Its mode of action is as a cholinesterase inhibitor. This means that it ties up or inhibits certain enzymes of the nervous system, called cholinesterases. When these enzymes are tied up, the signals to the nerves are not processed accurately. This results in eventual paralysis.

Does not bioaccumulate.

2-3 times more persistent than Diazinon.

Hydrolizes if in alkaline condition.

Toxicity: Oral LD_{50} (rat) 2.5 - 12 mg/kg; LD_{50} (birds) 7-15 mg/kg
Dermal LD_{50} (rat) 8.2 - 14 mg/kg

Moderately toxic to bees; less toxic to birds than Diazinon.

Moderately phytotoxic (toxic to plants).

Pacific Northwest Pest Control Handbook lists Demeton as a #1 Toxicity "most dangerous" to the sprayer. "Readily absorbs through the skin. Caution also required when handling plants up to 4 days after treatment. Precision is required against undue drift and contamination of livestock, forage, and food."

ROLE PLAY COMMITTEE

You are a representative of the Environmental Protection Agency

The EPA is a federal agency that has regional offices throughout the U.S. Region 10, your branch, covers Washington, Alaska, Idaho and Oregon. The EPA is responsible for seeing that federal laws are carried out locally. The EPA also can provide funds for states to do projects and surveys. This project and committee received such grant monies.

One of the few areas left where monies are available is that of hazardous wastes. Both RCRA and Superfund (see Laws and Regulations) concern hazardous waste disposal sites. Superfund can be used to help clean up old or abandoned sites. RCRA requires that all sites be strictly regulated.

Your concerns:

1. You want to make sure that any recommendations the committee might make would be consistent with EPA policy and that your agency would be able to support them.
2. You want to ensure that recommendations from the committee be realistic and possible to enforce or regulate. You would probably not encourage the committee's trying to "take on" the state or federal government at this point.
3. Your major concern is hazardous dumps. There are 200-250 of them in Washington State--many of which pose no problem. But some have been abandoned or are uncontrolled. These need close scrutiny. Your concern on this committee is to prevent hazardous wastes from becoming a problem at municipal dumps.
4. You know that states and local jurisdictions may require more stringent regulations than the federal laws. If they are less stringent, the federal law would take precedent.

ROLE PLAY COMMITTEE

You are a representative from a national conservation organization that has a local affiliate in your city.

Your group is an activist lobbying organization that works very hard to protect the environment and protect man from the effects of a polluted environment.

Your concerns:

1. You want to make sure that people don't dispose of anything in their creeks, rivers, or lakes. Fish and other wildlife need the streams and lakes for their survival.
2. You know that toxic substances can leach into surface or ground water and can then affect the environment and man. You want to make sure that people don't dispose of any toxic substance in their septic tanks. You know, for example, that a small community in Nassau County on Long Island, NY, has such a fragile ground water aquifer that the county has developed an ordinance prohibiting the sale or use of detergents containing phosphate-based builders such as trisodium phosphate (TSP).
3. You favor alternatives to using pesticides in the garden and for some household cleaners.

ROLE PLAY COMMITTEE

You are a representative of the Fire Department

Although your primary duty is to respond to fires, you also respond to citizens who need assistance in disposing of hazardous substances. Your primary concern is with flammable or explosive materials which may be stored, disposed of or used inappropriately. Occasionally, citizens might bring in jars or containers of substances they found when cleaning out the basement or garage. Sometimes the substances were not marked which made identification very difficult.

Your concerns:

1. You want people to know that a permit is required to store more than a 5 gallon can of gasoline (with the exception of the standard 6 gallon can for boat gas). Gasoline is a dangerous substance to store because of its flammability. One gallon of gasoline completely vaporized is explosively equivalent to 17 sticks of dynamite.
2. You would not recommend evaporating gasoline or solvents as a means of disposal because of the obvious fire hazard as well as the air pollution that would occur. Pouring these substances on the ground would likewise not be acceptable.
3. A permit from the Fire Department is required for any open burning on a lot as a means to dispose of anything from leaves, yard clippings, pesticide containers or household garbage. Burning transfers the pollution problem from the ground into the air. Burning also has the potential of increasing the toxicity of some pesticides, as well as increasing the probability of public exposure to the pollutants.
4. You are very concerned about the dangers of any substance that would be potentially explosive or flammable. You know that some hobby materials, for example, could create problems if not properly handled or disposed of.

ROLE PLAY COMMITTEE

You are a representative of the King Co. Cooperative Extension Service

The Cooperative Extension Service, part of the U.S. Department of Agriculture, is found in 50 states. In Washington State, the headquarters is located at Washington State University, with a branch office in Seattle. Although the Extension Service primarily supports agriculture, they also provide services to urban areas.

Your concerns:

1. You want people to have accurate information about products and disposal methods, as well as application of pesticides.
2. You feel that pesticides are a part of growing foods and that the home gardener should have few problems if he follows directions carefully.
3. You are aware of the pesticides that have been banned or have had their uses suspended. These products should not be used by homeowners but may be put away or stored in basements where they have been long forgotten. Your list includes:

   Aldrin
   DDT
   dieldrin
   mirex
   endrin/heptachlor
   chlordecone
   silvex
   2,4,5, -T
   parathion
   schraden
   sodium arsenite
   strychnine
   sodium flouride
   sodium cyanide
   toxaphene

3. You usually recommend that a homeowner dispose of a pesticide in one of three ways:
   a. apply all of a chemical according to label instructions,
   b. give the chemical to a neighbor to use up,
   c. take the container to Chem-Pro or the Health Department.

Your job:

Your agency provides bulletins, programs like Master Canners and Master Gardeners, and the Dial Extension Service. This last service provides over 400 tapes that anyone can request to hear over the phone by calling a toll-free telephone number. The number in Seattle is 344-7984. (There are toll-free numbers for communities outside the "344" calling area. There are several tapes that are of interest in this project:

# 18	Insects on Houseplants
# 258	Weed Control in Lawns
#400	Weed Control in Unplanted Areas Around the Home
# 422	Pesticides License Training
#424	Protect Bees from Pesticides
#771	Safe Storage and Use of Cleaning Products
#1291	Recycling Waste Motor Oil
#154	Insects in Vegetable Gardens
#420	Pesticide Safety
#423	Pesticide Disposal
#421	Pesticide Mistakes on Fruits and Vegetables
#777	Toxic Substances in the Home
#1600	About KC Coop Extension

ROLE PLAY COMMITTEE

You are a representative from the League of Women Voters.

The League of Women Voters is a non-profit, non-partisan group of local women (and men) who have three main functions; to register citizens to vote; to investigate issues, especially local ones/ and to take action to effect change on the local level as well as the national level. The national association lobbies in Washington D.C.

Your concerns:

1. You want citizens to see the big picture--what the big problems are with toxic wastes. Then you want individuals to realize that they, too, contribute to the big problem through unwise disposal of their household hazardous wastes.
2. You want people to take their unwanted pesticides, solvents, batteries, and etc. to the appropriate agency that will collect them.
3. You would probably favor local communities getting together to make decisions about their own household hazardous wastes. You favor a neighborhood "dump day" where citizens could bring pesticides, solvents, and other household toxicants to a central location for safe disposal. Maybe a company that professionally disposes of industrial hazardous waste would donate enough barrels for such a project.

Background: There are three leagues in King County. They focus on local policy and problems. Members get together to study and investigate the issues and then make informed decisions or vote on the issues. A concensus is then taken and a League Position is formed. After this step, action is taken. Sometimes this action is in the form of giving testimony at city council or agency hearings on the issues.

The state organization is presently working on a study of hazardous wastes in Washington State. This study will address who the generators are, who the regulators are, how wastes are managed in this state, what is being done on old sites, what the issues are in siting a "dangerous" or "hazardous " waste dump in Washington, and what public participation should be in that sitting process. The study will also cover consumer issues.

ROLE PLAY COMMITTEE

You are a representative of a company that is in the business of disposing of hazardous wastes

Your company accepts chemicals from industries and from homeowners for a fee. You will not accept radioactive waste, nor do you accept gasoline from homeowners. About 1 to 1½ million gallons of chemicals are collected from industrial sources each month. Homeowners contribute only about 4 55-gallon barrels a year, close to 200 gallons.

You dispose of the wastes in 4 ways:

1. most goes to the hazardous waste dump at Arlington, Oregon: sludge, pesticides, and solvents.
2. a small amount, like hardened bits and pieces, can go to a landfill open to commercial dumping, like Cedar Hills or Midway.
3. Some wastes can be treated and discharged into the sewer system.
4. Some solvents can be redistilled. The sludge goes to Arlington and the clean solvent can be reused.

Your concerns:

1. You wonder if people will suddenly flood your company with their unwanted pesticides, solvents, and other hazardous household substances. That would create a problem since you are set up to deal mainly with industrial wastes.
2. You know that collection systems can have their problems. For example, some substances are reactive and cannot be mixed with others.
3. You are very concerned about proper disposal. You will insist that hazardous or toxic substances be contained or stored properly and even that specific directions are given if such a material is to be transported from one place to another.

ROLE PLAY COMMITTEE

You are a representative of the Washington State Department of Ecology

As a state agency you have two major responsibilities in the area of hazardous waste. One is the job of regulating industrial waste. You have many federal and state laws that are very specific about what companies or industries can and cannot do with the wastes that they produce. You also, as an agency, have spill response duty along with the Coast Guard and E.P.A. You are usually called immediately if someone sees a spill of oil or chemicals, whether in a small neighborhood stream or in a major water right-of-way.

Your concerns:

1. The Revised Code of Washington (RCW 90.48.080) spells out your agency's concern with surface waters. It is illegal to throw or drain any organic or inorganic matter into any of the waters of the state that would cause pollution of those waters. In other words, you don't want anyone using the streams or lakes as a disposal option for any wastes!
2. You are concerned with the leaching of 1,1,1-trichloroethane from septic tanks into the groundwater. That chemical has been designated a priority pollutant by the E.P.A. You know that this chemical is found in septic tank cleaners as well as household cleaners.

ROLE PLAY COMMITTEE

You are a representative of WashPIRG

WashPIRG is an acronym for Washington Public Interest Research Group. PIRG's are non-profit, non-partisan public interest research/action organizations based in each state. At the University of Washington, WashPIRG is funded by voluntary contributions from students. You are a student who is getting credit for doing research on household product toxicity. You have been investigating groups of products, comparing costs, ingredients and effectiveness.

Your concerns:

1. You think people should be made aware of the toxicity ratings of some of the more hazardous products in the home--like spot removers.
2. You want people to be aware of alternatives to some household products.
3. You would like to see people buy in smaller quantities as opposed to buying larger quantities and then having an excess to dispose of or use unnecessarily.
4. You would be very interested in a survey that would provide some answers about what people buy and what they have in their homes that might be hazardous.

Your job:

Your job allows you to do research, formulate the findings, and then see that appropriate agencies, the legislature, or campus administration are informed of the results of your research when it applies to an issue they are dealing with. You are interested in discovering whether small or trace amounts of a toxic substance contained in a widely used product can contribute a real amount to the total. You are also interested in discovering whether labels provide sufficient information for consumers. You know that the chemicals of concern for household cleaners are organic solvents (e.g. toluene, VMP Naptha), chlorinated phenol disinfectants, caustic substances in detergents and other cleaners, and aerosols.

ROLE PLAY COMMITTEE

You are a representative of the Environmental Health Division of the King County Health Department

The King County Health Department is a regulatory agency. Recently they have established a pesticide collection program at each of the Department offices.

Your concerns:

1. You don't want people putting pesticides or toxic substances down their drains into their septic tanks. Leachate that is contaminated can, in turn, contaminate local groundwater and wells.
2. You don't want household toxic substances winding up in any place that they shouldn't. This would include landfills, sewer systems, or on the ground.
3. You want to make sure that restricted pesticides--for use by certified applicators only and not householders--are strictly regulated and that the applicators are tested and licensed.

Your job:

Your job might include the following:

1. Regulating and inspecting individual septic tanks. Over 90,000 homes in King County are on septic tanks. If any sewage seeps up to the ground from a tank you declare an immediate health hazard and repairs must be made immediately.
2. Inspection and regulation of all landfills and transfer stations in King County and City of Seattle. You make sure they are collecting what they are designed to collect and are not accepting any hazardous wastes.
3. Inspect and regulate private and small community water systems--over 500 of them in King County.
4. Test, license, and regulate professional pesticide operators who are using restricted pesticides. The City has an ordinance requiring this. The County does not.

ROLE PLAY COMMITTEE

You are a representative of Metro

In addition to operating buses and sewer systems, Metro is involved in protecting water quality in King County streams, lakes, rivers and Puget Sound. Some time ago Metro became concerned with the amounts and kinds of toxic substances which were entering Puget Sound as well as the wastewater treatment systems.

Your concerns:

1. You don't want people to use the sewer system as an easy disposal route for their hazardous household products.
2. You don't want people to use the waterways as a disposal system either. Water quality means protecting the water for people as well as for fish runs.
3. You want to advise people of all the disposal options and the effects of improper disposal.
4. You know that household solid waste and wastewater do contain heavy metals and organic chemicals that contribute to the total toxicant burden in solid (landfill) and liquid (sewage) wastes, but you are not sure that the amount is significant.
5. You want to make sure that any decision or suggestion made to the public is legal and enforceable.

ROLE PLAY COMMITTEE

You are a representative of King County Solid Waste

You are familiar with all of the transfer stations and landfills in the King County Solid Waste System. (See EVIDENCE, p. 27, and map on Garbage Dumps and Landfills, p. 28) in the SLEUTH Section). About 850,000 tons of garbage are moved from the transfer stations to the landfills each month. The King County Board of Health enforces the regulations and, in fact, monthly inspects the transfer stations and landfills, monthly.

Your concerns:

1. You want to make sure that people don't dispose of any hazardous waste in the garbage. This would include any substance that was explosive, radioactive, reactive, or toxic.
2. You know that pesticide containers must be triple rinsed and decontaminated before being disposed of in the trash.
3. You know that incineration of pesticides and other toxic wastes is not only dangerous but illegal.
4. You are concerned about the total number of hazardous household products that may be ending up in the landfill and about possible contamination of the leachate.

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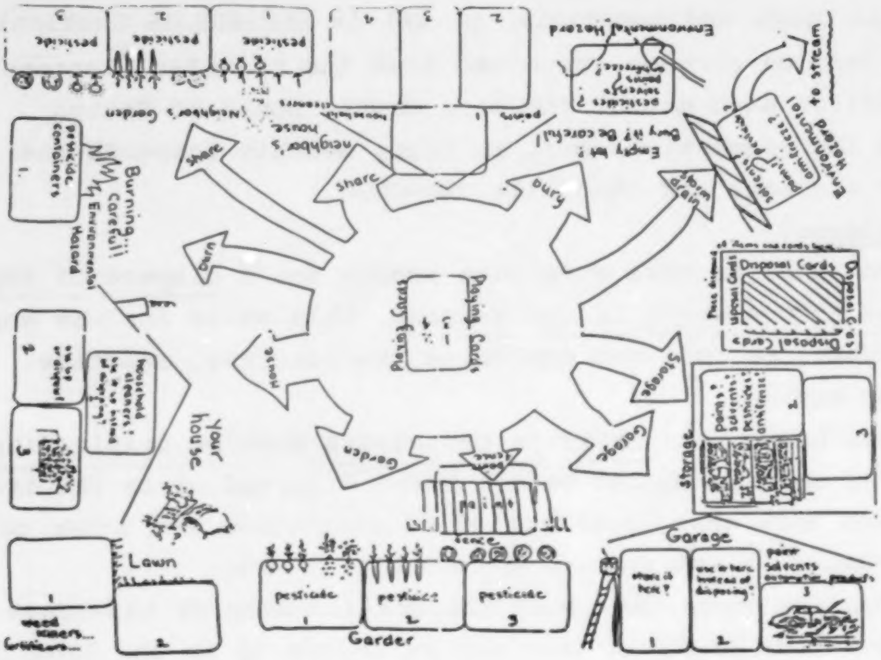
game

DISPOSAL!



THE GAME is played with cards that represent a number of possible household hazardous waste disposal problems and a few special solutions.

THE DISPOSAL CHALLENGE: Would you rather USE or DISPOSE of a substance? How long will you hold on to a substance before needing to dispose of it? Are there secrets in this game? Will you show the other players what you drew from the stack?

THERE ARE NO RIGHT AND WRONG ANSWERS in this game--only personal choices, which thereby reflect the "real world". If students have done the Sleuth and other activities, they should be adequately prepared to use the choices in the game as a meaningful learning activity. However, for teachers who may use the game as their primary mode of instruction for this topic, we have included a TEACHER's KEY: GENERAL COMMENTS (p. 149), DISPOSAL CARDS (p. 153) and CARD NUMBER NOTES (p. 153).

game

DISPOSAL!

2 - 4 players 20-30 minutes

Procedure: Duplicate copies of the 4 pages that form the playing board. Place them so that the numbers in the 4 corners fit together like this in the center: $\frac{1|2}{3|4}$ Tape sides.

Duplicate one set of "playing cards". There are 60 cards in all. Cut down and across the center of the large black lines.

Duplicate copies of this page. Each player should have a set of the instructions and 6 Disposal Cards in his possession before playing.

Object of the Game: Try to get rid of all unwanted or extra household hazardous wastes that come into your hand through the course of play. Players can work together to solve some disposal problems.

To Start: Set up the board. Shuffle the cards thoroughly. Place stack of cards in the space provided on the "board". Make sure each player has a set of disposal cards.

To Play: Note that there are several areas on the board where substances could be USED, SHARED, or STORED. For example, a can of paint could be shared with a neighbor or stored in your garage. There are only a few storage places offered; they may be used up rapidly.

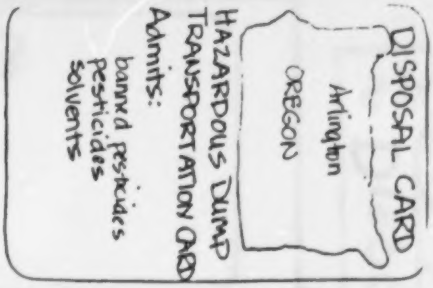
The first player draws a card from the playing cards. The card may give the player something to dispose of--a can of paint, a pesticide, household cleaner, automotive product or solvent. The task is to decide what to do with it. You can:

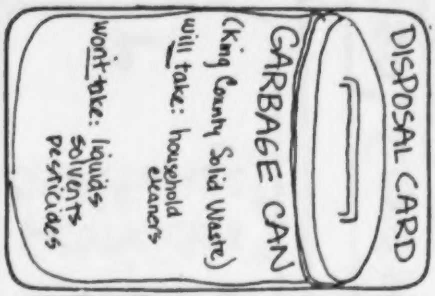
-play it on the board in an available space--SHARE, USE, OR STORE. (There are also a couple of illegal disposal options..use at your own risk.)

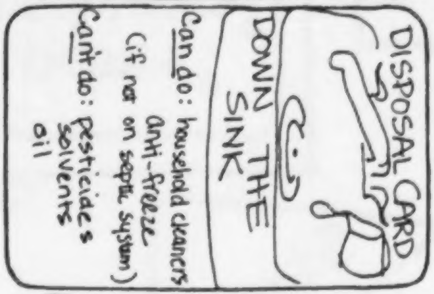
? -choose to DISPOSE of it, using one of your disposal cards. (But once you have used that card..it's gone...)

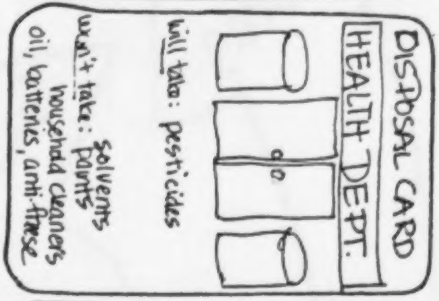
-HOLD in your hand until another play.

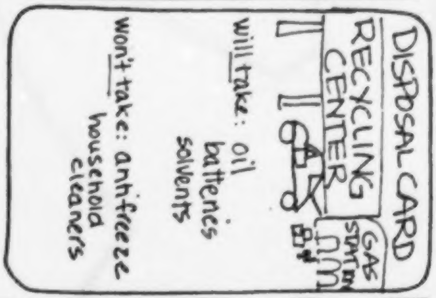
The Playing Cards: Besides disposal challenges, you may also draw additional disposal cards, actions, fines or penalties, or directions for all players to follow.

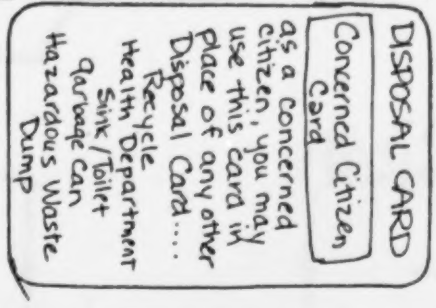


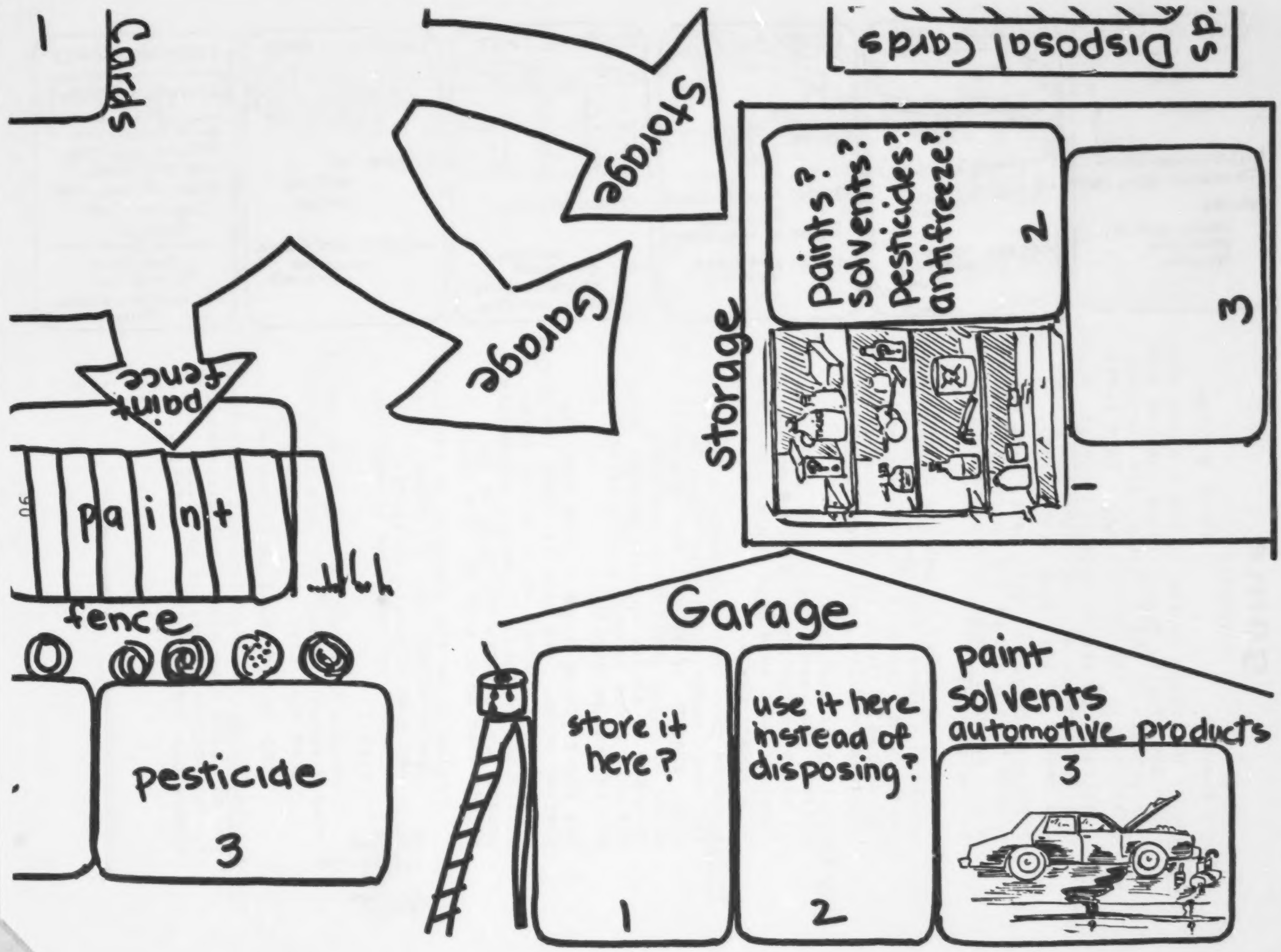




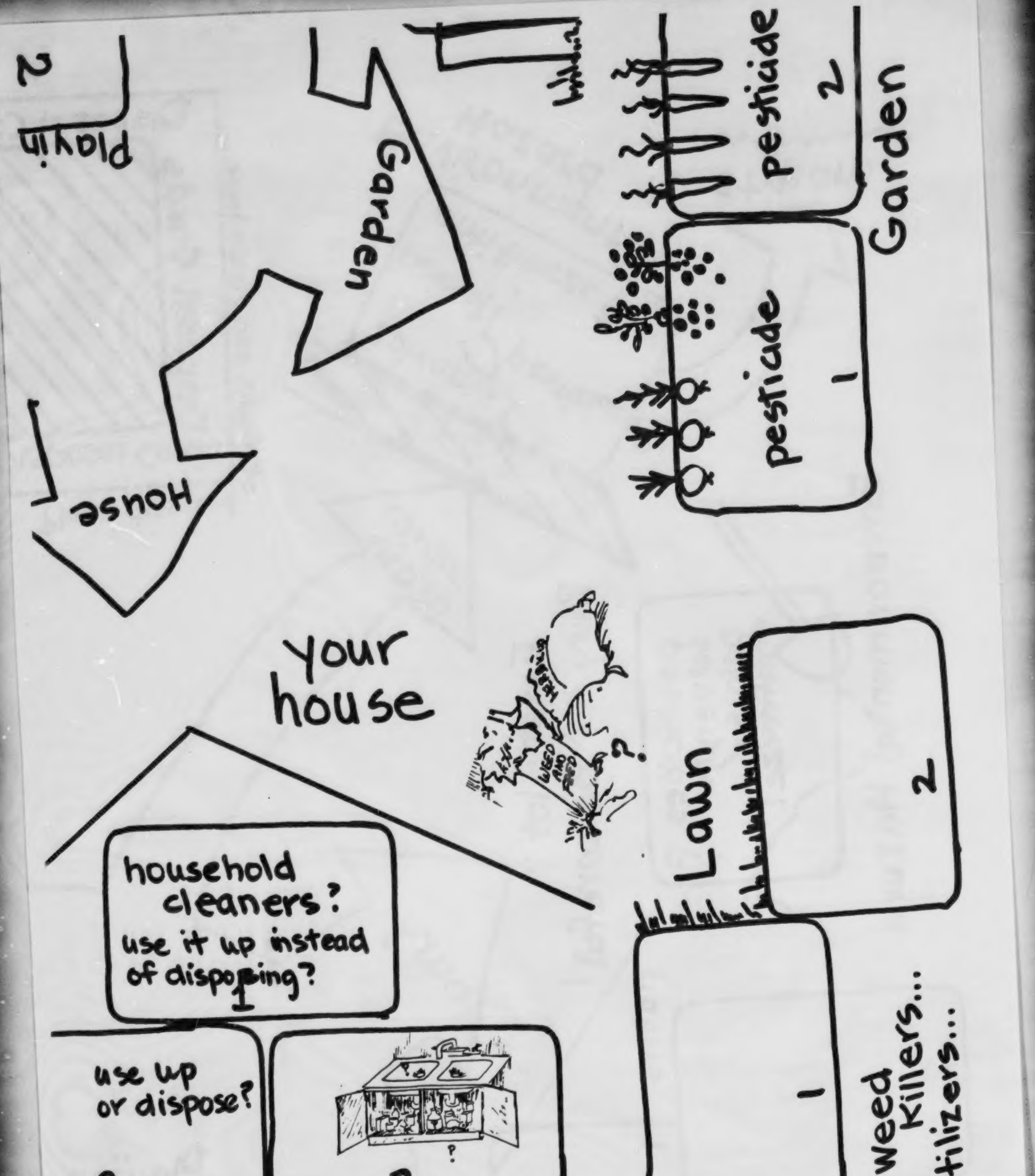


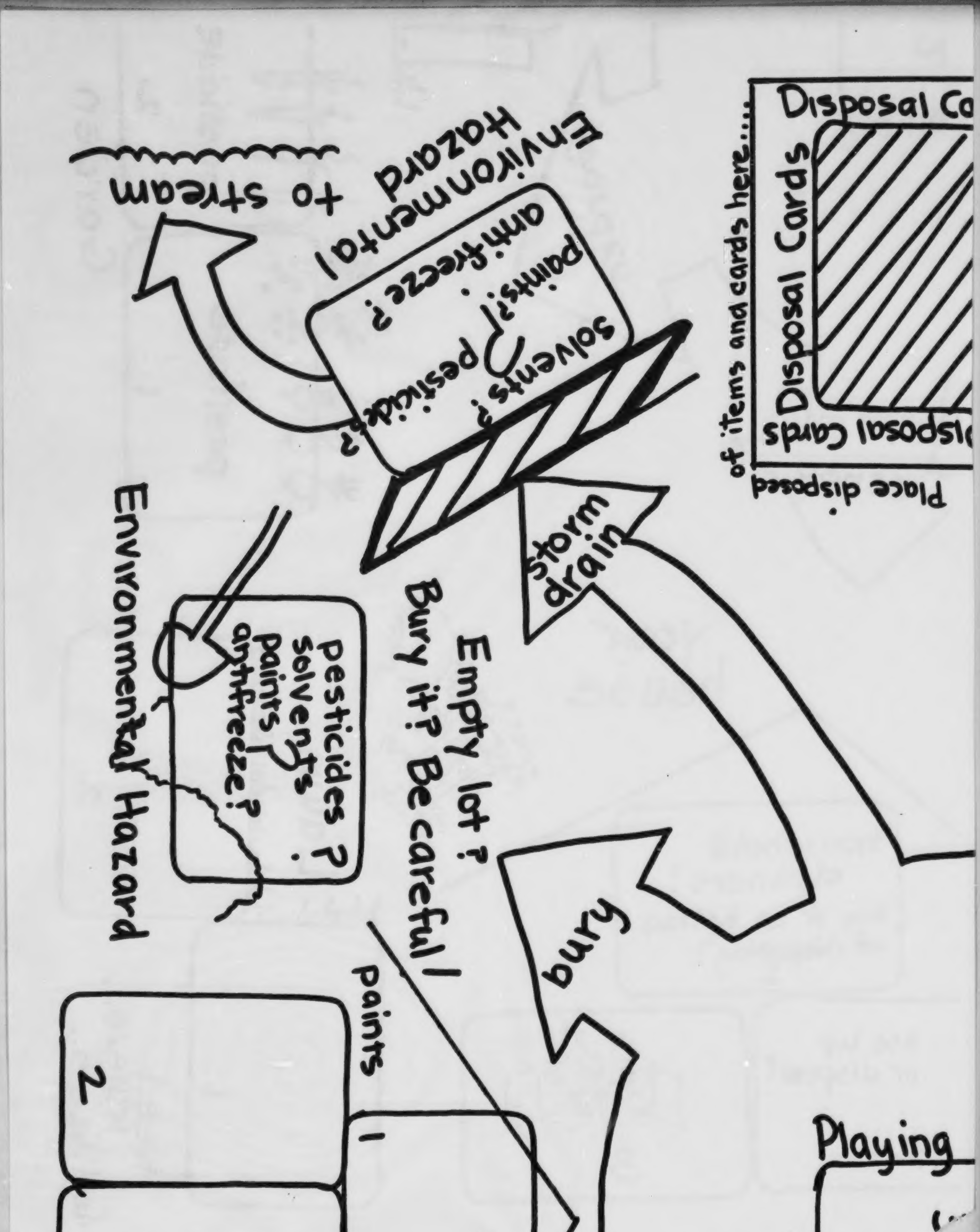


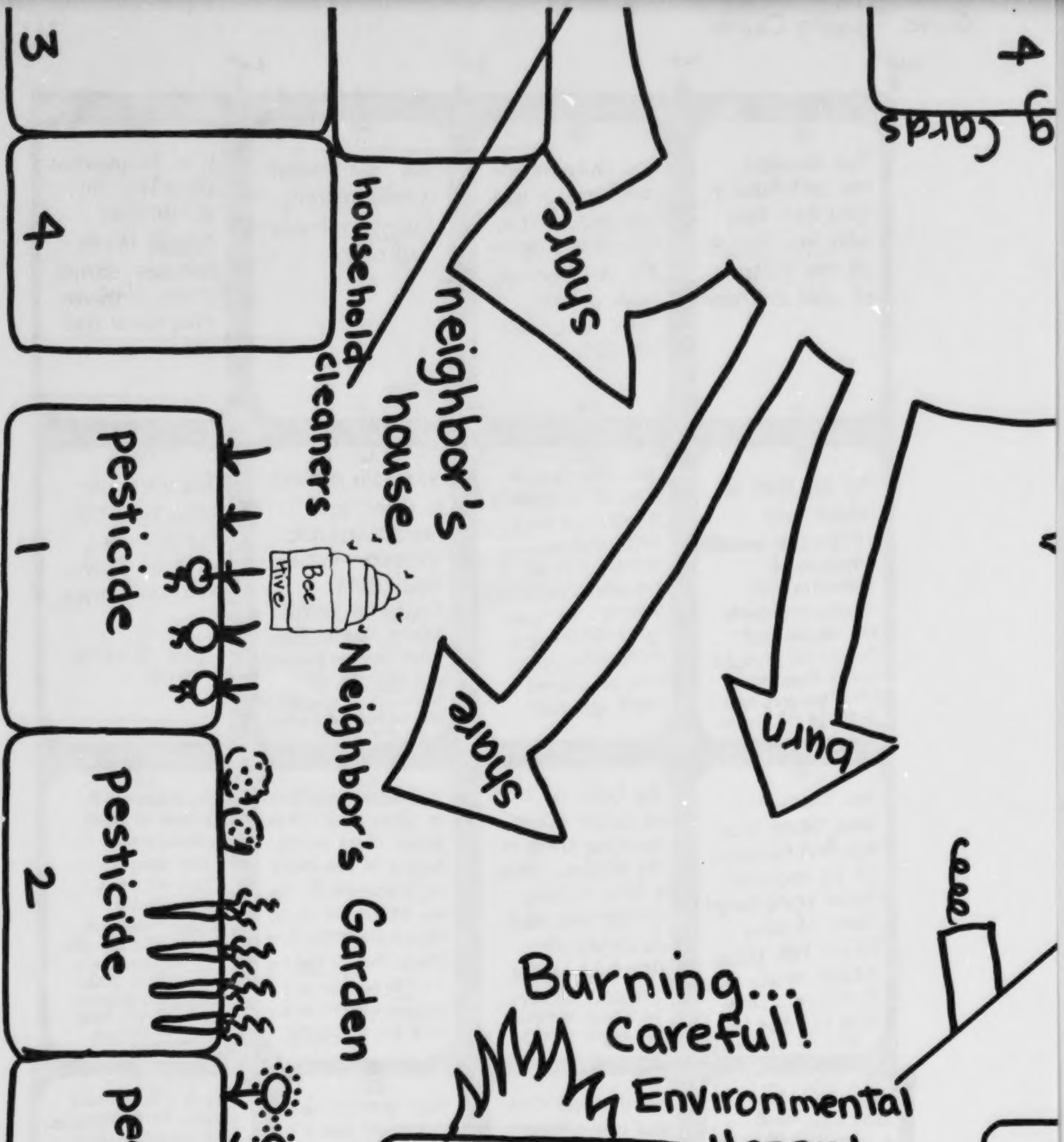




Cards
1
sp. Disposal Cards
Storage
Garage
paint fence
paint
fence
pesticide
3
Storage
paints?
solvents?
pesticides?
antifreeze?
2
3
1
Garage
store it here?
1
use it here instead of disposing?
2
paint
solvents
automotive products
3


your house
household cleaners? use it up instead of disposing?
1
use up or dispose?
2
3
?
Weed and Feed
?
Lawn
2
1
weed killers... fertilizers...
House
Garden
Playin
2
pesticide
1
pesticide
2
Garden


Environmental Hazard
to stream
Solvents? pesticides?
paints?!
antifreeze?
Disposal Co
Disposal Cards
Disposal Cards
isposal Cards
Place disposed of items and cards here.....
storm drain
Empty lot? Bury it? Be careful!
pesticides? solvents?
paints
antifreeze?
Environmental Hazard
bury
Paints
2
1
Playing


4
g Cards
3
4
share
household cleaners
neighbor's house
Bee Hive
Neighbor's Garden
pesticide 1
pesticide 2
pesticide 3
share
burn
Burning... Careful!
Environmental Hazard
pesticide containers
1.

Game Playing Cards:

cut cut cut cut

① You changed the antifreeze in your car. How will you dispose of the gallon of used antifreeze?

A

② You changed the antifreeze in your car and have a gallon to dispose of. However, you have a septic tank. What will you do?

A

③ You just bought a new battery. Dispose of your old one.

A

④ It is Neighborhood Dump Day. All players may dispose of any pesticides, solvents, paints or thinners They hold in their hand.

⑤ You volunteer to collect your neighbor's unwanted amounts of pesticides and transport them to the Health Dept. Collect all pesticide cards from the other players and dispose of them.

⑥ You volunteer to work on a committee to draw up some recommendations on the disposal of household hazardous waste. For your good deeds, you may dispose of any unwanted card you hold.

⑦ You have decided to paint your house and are too poor to buy new paint. Collect all excess paint cards from your fellow players and dispose of them. Your house will be the most colorful on the block!

⑧ You were just cited by DOE for dumping used antifreeze in a local stream.

Take 2 extra turns.

⑨ You check the local storm drain and find evidence of oil and antifreeze being dumpd there. If any player has placed a card there - issue a ticket.... and give his card back to him. (2 extra

⑩ The DOE is concerned about people dumping things in the stream. Issue a fine to any player who has disposed of anything in the stream. (They will have to take an extra turn)

⑪ You have volunteered to speak to a grade school class on the subject of household hazardous waste. You will stop by the solvent reclaiming service first - Check the garage and the storage for any solvents you can take with you to dispose.

⑫ You discover 3 gallons of wood preservative in your garage. This stuff is technically classified as a pesticide. If you can explain why - you may dispose without a disposal card. If not, hang on until you can Dispose.

⑬ Your pet died and you have a box full of pet sprays, flea collars, and pet insect repellent. Will you share or Dispose?

⑭ You discover that your oven cleaner is toxic. You decide to switch to baking soda as an alternative. How will you Dispose of the almost full aerosol can you have?

⑮ Your brother-in-law gives you a gallon of Paint Thinner.
Will you
Share
Dispose
or
Store?

⑯ This is a concerned citizen card. Because you educate your neighbors and friends - you must give this to another player who may then use it to dispose of 1 item in his hand.

Game Playing Cards:

cut cut cut cut

⑰
Your floor wax irritates your nasal passages. You decide to dispose of the ½ gallon you have left.

HC

⑱
You have 5 gallons of yellow latex paint left over from painting the outside of your house. Will you share or dispose?

Pt.

⑲
You have 2 gallons of white paint left over from painting the outside of your house. Will you share or dispose?

Pt.

⑳
You just finished painting your house with an oil-based paint. You have a gallon of paint thinner that you used to clean the brushes with. How will you dispose?

Pt.

㉑
Your father-in-law finished staining his house a dark brown. He had 2 gallons left over and gave them to you. Will you use them on the fence? or share or dispose?

Pt.

㉒
You have 1 gallon of green paint left over from painting Rover's dog house. Will you share or dispose?

Pt.

㉓
You have 2 gallons of red paint left over from painting your brother's house. Will you share or dispose?

Pt.

㉔
You were cleaning out the garage and found a dozen cans of various colors of paint left over from old projects. Will you share or dispose?

Pt.

㉕
You have a can of mixed gasoline and motor oil you used on the lawnmower. You switched over to a less noisy hand push mower and have 1 gallon of the gas mixture left. How will you dispose?

S

㉖
Because your garage is such a mess, you find you actually have about 3 gallons of turpentine in various containers. That's a lot. How will you dispose of it?

S

㉗
You have a gallon of lacquer thinner that you no longer want around. Dispose or share.

S

㉘
You have several jars and cans in the garage with some sort of solvent in them. In fact, the brushes are still in the containers. Most of the solvent has evaporated. How will you dispose?

S

㉙
You just changed the oil in your pick-up. You now have 7 qts. to dispose of.

A

㉚
You just changed the oil in your compact car. You now have 3 qts. to dispose of, or store.

A

㉛
You just changed the oil in your car. You now have 5 qts. to dispose of or store it.

A

㉜
You just changed the oil in your compact. You now have 3 qts. to dispose of... or store it.

A

cut down the centers of the large black lines

it ↓ cut ↓ cut ↓ cut ↓ cut

㉝
You just learned that ingredients in your "Grass Grow Greener" fertilizer can leach into a local stream. You are concerned and want to dispose of the 20 lbs. you have left.

P

㉞
You just learned that the fly control pesticide you have been using is Naled. It is toxic to bees. Your neighbor has 2 hives so you decide to dispose of what you have left.

P

㉟
You have 4 lbs. of Diazinon left over from last year to dispose of. You have decided to try your garden without pesticides or fertilizers this year.
will you share or dispose or store?

P

㊱
You choose to use fish fertilizer in your garden. You may use this card in any garden space, even if it is full.

P

㊲
You have 10 lbs of "Weed-be-killed" for your lawn. Use or dispose or share.

P

㊳
You buy some Systox to get rid of aphids on your roses. But the package is larger than you need and you have ½ lb. to dispose of or share.

P

㊴
You discover an old box of rat poison in the basement, left there by a previous owner. Dispose quickly!

P

㊵
You discover a box of Chlordane in the basement, left by a previous owner. Dispose of this banned pesticide. or ask for help from your fellow players.

P

㊶
You have 1 lb of slug bait. Use it, dispose or share

P

㊷
You bought too much Captan to treat your potatoes before you planted them.
Use, dispose, or share

P

㊸
For some reason you have ½ lb of Sevin in the garage. You read the label and note that it is toxic to bees. Will you use it or dispose? or share this pesticide with a neighbor. P

㊹
Your neighbor brings you a carton of parathion. This pesticide is now banned. How will you dispose?

P

㊺
You have an allergic reaction to your oven cleaner. How will you dispose of the rest of the can? or will you share it with a neighbor?

HC

㊻
You have 2 cans of a drain cleaner you bought on sale. But your sister is coming to visit. She has small kids and you want to get rid of the stuff. How to dispose? or will you share or store it?

HC

㊼
You look on a back shelf and find an old bottle of dry cleaning fluid — carbon tetrachloride You read the label. It sounds like something you don't want around. How do you dispose?

HC

㊽
You bought 1 lb of TSP for cleaning purposes. But you have been reading about the effects of phosphates on lakes and streams and decide to dispose of or share what you have left.
HC

Game Playing Cards

cut cut cut

㊾
Your grandmother just brought over 1 lb. of DDT she had in her garage since W.W.II.
You must dispose of it. This is a banned pesticide.
P

㊿
Your mother-in-law sent you a carton of aerosol air fresheners for your birthday. There are 12 cans in the box. You would rather just leave the window open.
Will you use, share, or dispose?
Hc

(51)
You just changed the antifreeze in your pickup. How will you dispose of the gallon of used anti-freeze?
A

(52)
You have 3 lbs of slug bait.
Use it or dispose or share
P

(53)
You have 1 gallon of paint left over from painting your garage. Will you share or dispose?
Pt.

(54)
The Local Health Department is holding a drive to collect unwanted pesticides. All players may dispose of any in their hand.

(55)
You have 1 lb of Diazinon.
Use it or dispose or share this common pesticide.
P

(56)
You just discovered a 5 gallon can of gasoline in the back of your garage. You don't know how long it has been there nor whether it has water or oil in it. How will you dispose?
S

(57)
Your local gas station will now accept waste oil. Collect any that your neighbors may have and Dispose.

(58)
You decide to switch to 1/4 cup bleach in 1 qt water as a household disinfectant. How will you dispose of the one gallon of "Wonderclean" you have?
(share, use up, dispose)
Hc

(59)
You just changed the oil in your car. You now have 5 quarts to dispose of.
A

(60)
If you can identify four sources of household hazardous wastes.....
Skip the next 2 turns.

section III

THE BIG PICTURE

In Section III, we try to take a few steps back and look at the issue of household hazardous waste within the context of other issues. That is, not only your house...everybody's house... your job...everyone's job....your future....everyone's future.

HAZARDOUS TRIVIA (p. 100-107) and HAZARDOUS ISSUES (p. 108-113) are values clarification exercises and help to point out the complexity of the issues. This can be done by the students alone or in small groups. The activities called WHAT DO YOU DO IF YOU DON'T KNOW can be done at any time when the students have reached a frustration level because of a lack of information--they are good exercises to put it all in perspective.

The LAWS section and UNRAVELLING RED TAPE worksheet both provide basic information and are designed to promote class discussion. They could provide a review for many of the concepts and vocabulary used throughout this teaching unit. The worksheet will also help to generate independent reseach by the students, or perhaps you would like to set up a formal debate (or play "devil's advocate") on some of these points.

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THE BIG PICTURE(your house..everyone's house..your job...everyone's
job..your future..everyone's future...)

HAZARDOUS TRIVIA

There are a lot of shocking facts around these days, and some that are not so shocking. The problem is to tell which are which. There are two difficult questions that need to be answered to help you make your decision:

1. How much are they talking about (UNITS)?

How big is a ton? How much is a ton? What shape is a ton? Does a ton move, attack, subvert?
How little is a gram? Will it harm you? Does it blow away? If it doesn't blow away, will a milligram blow away?
How much is a billion? Will it fit into your yard? Your city? One bank or twenty banks? Is a billion enough to get by on? Will it suffocate you? Is it shocking or really nothing at all?
How much is a thousand? Enough? Too much? Too little? Can you picture it in one minute? In five minutes? In one second?
Units are especially difficult to deal with when you are concerned with the minute world of chemicals.
A shocking amount of salt might be 4,000 tons, unless you are a deer or an ant. A shocking amount of gold might be one cup. A shocking amount of cyanide might be one drop.

2. Does it matter (VALUES)?

Values are slippery. They depend on so many things. Your knowledge. Your ignorance. Your likes and dislikes. Your trust in science, in your own mind, in the minds of others, in people who are different from you. Your perspective on nature... how resilient are forests, plants, soils, waters to the stresses that occur to them? Your perspective on time..will nature heal a forest fire area in twenty years or in one hundred? Does it matter? Will nature heal a hazardous chemical spill in five years or five hundred?

The challenge of Hazardous Trivia should be to determine whether the facts are hazardous or are trivial, and not just to note or to memorize them. First, estimate answers to the questions below. Then check your estimates with the answer key. Finally, and most importantly, give the units some thought, give them your values, and decide: are they hazardous or are they trivial? Discuss with your class or your friends. Should the following facts shock or startle people? Or are they no big deal?

HAZARDOUS? or TRIVIAL?

1. How many chemicals are produced in the United States each year? ____________

2. How many new chemicals are developed every year in the U.S.? ____________

3. How many chemicals are now entered in the registry of chemicals of the American Chemical Society? ____________

4. How many of these are in common use? ____________________

5. How many of these are scientists looking for in Puget Sound waters and sediments? ____________________

6. How many spills of hazardous pollutants occurred in Puget Sound between 1975 and 1979 as recorded by the U.S. Coast Guard? ____________

7. One of these spills was hydrochloric acid. How many gallons went into the Sound? ____________________

8. How many tons of hazardous materials are transported every second in the U.S.? ____________________

9. How long before manufacturing a new chemical does the public (E.P.A.) have to be notified? ______________

10. A NOAA study of pollutants in suspended matter in Puget Sound found the following metals: arsenic, copper, aluminum, iron, silicon, titanium, lead, antimony, zinc. Which of these elements are on the EPA list of priority (toxic) pollutants? (Circle)

10a. How many chlorinated compounds were found in Hylebos Waterway (Commencement Bay) by the same study? _______

11. What percent of hazardous wastes are reclaimed or recycled? _____________

12. The volume of groundwater in the U.S. is about 50 times the yearly flow of surface water. Approximately how many gallons of fresh groundwater occur within one half mile of the surface?

How does this amount compare to the volume of the Great Lakes? ____________________ times

13. Ground water supplies what percent of the fresh water used for all purposes in the country? ___________

14. What percent of residents in the country rely on ground water for drinking? ____________________

Contamination of ground water from human activities may come from landfills, agriculture, industrial surface impoundments, leaks and spills, land disposal of waste water, septic tanks, mining, petroleum and natural gas production, and other sources.

15. Of 8,163 industrial waste surface impoundments sampled in the U.S., what percent had no lining? ____________________

16. What percent had no monitoring system to check for contamination of ground water? ____________________

17. In a 1977 study of 50 industrial disposal sites, how many sites were found to have organic contaminants such as chlorinated phenols, benzene and its derivatives, PCB's, and organic solvents in the ground water? ________

18. How many of these sites had chemicals which had begun to leach? ________

19. How many sites had metals which contaminated the ground water? ________

Of four hundred eleven drinking water wells tested in New Jersey, what percent of the wells were contaminated with ...

20. trichloroethylene, a widely used solvent and degreaser which causes cancer in mice ____________________

21. 1,1,1 trichloroethane, a widely used solvent ____________________

22. As with all sewage treatment plants across the nation, we add chlorine to our sewage before the water flushes into Puget Sound. How many tons of chlorine a day do we use to treat the sewage of 900,000 Puget Sound residents? ____________________

23. Of thirty public water systems treated in New York, how many contained some contamination by synthetic organic chemicals? ____________________

24. In 1980, how long did the E.P.A. estimate that it would take to issue the 30,000 permits needed for disposal site operators to act under interim permit standards before permanent permits are issued? ________________

25. How much did a company offer to pay the country of Sierra Leone in return for permission to dispose of hazardous wastes which would be left over from a hazardous waste recycling plant there? ____________________________

26. How long can it take chronically toxic substances to produce adverse health effects? ___________________________

How many milligrams per kilogram of body weight of the following substances would it take to kill a healthy human? (estimate a range) .....

a) antifreeze, household bleaches, many detergents, many oven cleaners, metal cleaners, shoe polish, most paints? __________________

b) dry cell batteries, glass cleaners, hand soap ? _________

c) most toilet bowl cleaners, some deodorizers, some paint brush cleaners, lacquer thinners, some fertilizers, many pesticides?

____

d) a few super toxic pesticides like paroxon, parathion, isobenzan?

____

27. How many pounds of pesticides were sold in a year in the U.S.?___________

- ANSWERS -

HAZARDOUS? or TRIVIAL?

1. How many chemicals are produced in the United States each year? 60,000

2. How many chemicals are developed every year in the U.S.? 1,000 to 5,000

3. How many chemicals are now entered in the registry of chemicals of the American Chemical Society? over 4,000,000

4. How many of these are in common use? 63,000

5. How many of these are scientists looking for in Puget Sound waters and sediments? 200

6. How many spills of hazardous pollutants occurred in Puget Sound between 1975 and 1979 as recorded by the U.S. Coast Guard? 2500

7. One of these spills was hydrochloric acid. How many gallons went into the Sound? 100,000

8. How many tons of hazardous materials are transported every second in the U.S.? 125 tons

- ANSWERS -

9. How long before manufacturing a new chemical does the public (E.P.A.) have to be notified? 90 days

10. A NOAA study of pollutants in suspended matter in Puget Sound found the following metals: [✓ arsenic] [✓ copper], aluminum, iron, silicon, titanium, [✓ lead], [✓ antimony], [✓ zinc.] Which of these are on the EPA list of toxic priority pollutants? (circle)

As Cu Pb Sb Zn

10a. How many chlorinated compounds were found in Hylebos Waterway (Commencement Bay) by the same study? 18

11. What percent of hazardous wastes are reclaimed or recycled? 2%

12. The volume of groundwater in the U.S. is about 50 times the yearly flow of surface water. Approximately how many gallons of fresh groundwater occur within one half mile of the surface?
36 quadrillion gallons
How does this amount compare to the volume of the Great Lakes? 4 times

13. Ground water supplies what percent of the fresh water used for all purposes in the country? 25%

14. What percent of residents in the country rely on ground water for drinking? 50%

- ANSWERS -

Contamination of ground water from human activities may come from landfills, agriculture, industrial surface impoundments, leaks and spills, land disposal of waste water, septic tanks, mining, petroleum and natural gas production, and other sources.

15. Of the industrial waste surface impoundments or landfills in the U.S., what percent have no lining? 70%

16. What percent have no monitoring system to check for contamination of ground water? 95%

17. In a 1977 study of 50 industrial disposal sites, how many sites were found to have organic contaminants such as chlorinated phenols, benzene and its derivatives, PCB's, and organic solvents in the ground water? 40

18. How many of these sites had chemicals which had begun to leach? 27

19. How many sites had metals which contaminated the ground water? 49

Of four hundred eleven drinking water wells tested in New Jersey, what percent of the wells were contaminated with ...

20. trichloroethylene, a widely used solvent and degreaser which causes cancer in mice 27%

21. 1,1,1 trichloroethane, a widely used solvent 48%

22. As with all sewage treatment plants across the nation, we add chlorine to our sewage before the water flushes into Puget Sound. How many tons of chlorine a day do we use to treat the sewage of 900,000 Puget Sound residents? 5 tons

23. Of thirty public water systems treated in New York, how many contained some contamination by synthetic organic chemicals? 100

- ANSWERS -

24. In 1980, how long did the E.P.A. estimate that it would take to issue the 30,000 permits needed for disposal site operators to act under interim permit standards before permanent permits are issued? 5 years

25. How much did a company offer to pay the country of Sierra Leone in return for permission to dispose of hazardous wastes which would be left over from a hazardous waste recycling plant there? $25,000,000

26. How long can it take chronically toxic substances to produce adverse health effects? 15 - 20 years, longer

27. How many milligrams per kilogram of body weight of the following substances would it take to kill a healthy human? (estimate a range) .....

   a) antifreeze, household bleaches, many detergents, many oven cleaners, metal cleaners, shoe polish, most paints? 500 - 5000 mg/kg

   b) dry cell batteries, glass cleaners, hand soap ? 5000-15,000 mg/kg

   c) most toilet bowl cleaners, some deodorizers, some paint brush cleaners, lacquer thinners, some fertilizers, many pesticides? 50 - 500 mg/kg

   d) a few super toxic pesticides like paroxon, parathion, isobenzan? less than 5 mg/kg

28. How many pounds of pesticides were sold in a year in the U.S.? 1 billion

THE BIG PICTURE (your house..everyone's house..your job..everyone's job..your future...)

HAZARDOUS ISSUES

Do you like taking sides? Do you like exercising leadership? Do you like others to decide for you?

The disposal and use of hazardous substances is a new issue. We simply hadn't let all these rabbits out of the magic hat of technology one hundred or even fifty or even thirty years ago, and they were not running or hopping about giving us surprises. In 1981 alone, 30,000 more came out of the hat!

All issues involve controversy. The new issues surrounding hazardous and toxic wastes will be particularly controversial both because they can be life and death issues. They are also controversial because there is no clear proof on how many man-made chemicals will act once they are released into the environment. People can also argue that there is not enough proof or that there is enough proof! The chemicals have been tested in the laboratory--the best means we have available. As with other ecological issues, however, nature will take her time to tell us what the results will be in the world outside the laboratory.

And yet we are making decisions now. And we want to be making these decisions now. What should happen?

The following statements represent two opposite positions one might take on hazardous waste issues, sometimes stated in the extreme. First mark a point on the line which indicates where your knowledge, perspective, or values might lead you to stand.

Second, and most importantly, go to the worksheet on page 113. After noting where you stand on statement A or B, write why you stand there and list the additional kinds of information you would need to feel comfortable or certain of your position.

strongly agree	somewhat agree	undecided	somewhat agree	strongly agree

(A)	(B)
1) Health and safety data on any chemical should be available for any member of the public who cares to look at it.	Manufacturers should be allowed to keep health and safety data secret.

THE BIG PICTURE.....HAZARDOUS ISSUES continued

(A)	(B)
2) Chemical companies should pay for the testing of their chemicals.	Taxes should be used to pay for the testing of chemicals.
3) When registering a chemical, manufacturers should be required to file complete results of toxicity tests which could then be reviewed by independent scientists to check the conclusions.	When registering a chemical, manufacturers should be required to file a very brief summary or abstract of the data, stating their conclusions.
4) Laboratories under contract to a chemical company can be trusted to provide independent and unbiased data in their tests.	Laboratories under contract to a chemical company cannot be trusted to provide independent and unbiased data in their tests.
5) All states should act under the same set of federal regulations.	States should be able to set their own regulations for hazardous waste disposal and use.
6) States or communities should be able to set disposal standards that are stricter than those set by the federal government.	States or communities should not be able to set standards that are stricter than others because it will be too difficult and expensive for industry and manufacturers to follow different standards in each state.

THE BIG PICTURE....HAZARDOUS ISSUES continued

(A)	(B)
7) We should try to limit our consumption of synthetic products - nylon, plastic - that tend to generate toxic or hazardous wastes during their manufacture.	We should take advantage of the benefits of modern technology and enjoy the products, hoping that safe means of disposal can be implemented.
8) We should only use products that have hazardous or toxic wastes if they are of essential benefit: plastic components of pace makers for hearts, transportation. food supply. etc.; and not for inessential benefits: swizzle sticks, pink flamingoes for a yard, pop bottles, etc.	No one should be able to say what is an essential benefit to another person. The market place is the best way to make these decisions.
9) Animals should not be sacrificed for chemical testing.	It is very reasonable to sacrifice a few hundred white rats, pigs, monkeys, etc. in order to find out how a chemical might affect humans.
10) We should ship our hazardous wastes to other countries if they are willing to receive them and the money they would be paid.	We should not ship our wastes to many other countries because the level of literacy is such that a majority of the population will not know enough about chemicals to know whether or not they want them.
11) The price of disposing of wastes should be included in the price of the product.	Taxes should be the means used to pay for waste disposal.

THE BIG PICTURE....HAZARDOUS ISSUES continued

(A)	(B)
12) The federal government should be able to determine where hazardous waste dumps should be located.	Local communities should be able to determine that they not have a hazardous waste dump if they do not want one.
13) Currently, chemical industry representatives present data about a new chemical to the EPA and government representatives who then decide which chemicals should and should not be allowed on the market. This process is adequate.	The current process is inadequate because independent sources do not have the opportunity to evaluate the adequacy of the data, or otherwise participate in these decisions, and their priorities and concerns may be different from those of the chemical industry.
14) Experts should decide issues about chemicals because most of us do not know enough.	Non-expert but concerned people should decide issues about chemicals because experts may not have the same values.
15) We should try wherever possible to do things in such a way that no toxic or hazardous substances are required.	We should not try to find alternative practices to our current use of toxic substances because this would adversely effect the chemical industry.
16) Household quantities of wastes are small enough that they should not be regulated like industrial wastes.	Household quantities of toxic substances should be regulated the same as industrial quantities.

THE BIG PICTURE....HAZARDOUS ISSUES continued

17) We know far too little about the 60,000 chemicals a year we put on the market, and should be exercising more caution.	We have adequate testing before putting chemicals on the market, and we can pull them off once we get an indication they are harmful. We are exercising adequate caution.
18) Hazardous or toxic substances are not a problem if properly applied according to health and safety regulations.	Hazardous or toxic chemicals should not be used at all if possible.
19) The ocean is large and resilient, an ideal place for diluting hazardous wastes, and should be used for dumping.	Ocean dumping of hazardous wastes should not be allowed.
20) The economic health of a major northwest industry, timber, should not be threatened by curbing forest spraying for pests.	It is more important that we keep a a healthy ecosystem than that we guarantee a healthy forest economy.
21) We should keep local people employed with jobs such as cutting grass and weeds on roadsides, pulling trees out of rights-of-way if they endanger transmission lines, weeding and landscaping public gardens, etc., rather than using pesticides.	Pesticides are convenient and very effective and should be used for such purposes

HAZARDOUS ISSUES - WORKSHEET

Statement #____. I stood towards side ___, and felt ________________.
Why I stood for that:

What further information I would need to know in order to feel certain of my position.

Statement #____. I stood towards side ___, and felt ________________.
Why I stood for that:

What further information I would need ...

Statement #____. I stood towards side ___, and felt ________________.
Why I stood for that:

What further information I would need ...

Statement #____. I stood towards side ___, and felt ________________.
Why I stood for that:

What further information I would need ...

Statement #____. I stood towards side____, and felt ________________.

What further information I would need ...

BIG PICTURE: WHAT DO YOU DO WHEN YOU DON'T KNOW?

Check which of the following reactions you tend to have when you are in a situation where you do not know what the answer is or how to act. Explain why you think you react that way, and give an example of the situation (for examples, see p. 17).

	WHY	IN WHAT SITUATIONS?
Go ask someone.		
Go research an answer myself.		
Fake it.		
Withdraw		
Argue, in order to find what others might say.		
Spend time alone until an answer comes to me.		
Act, and watch what happens.		
Nothing		
Gut it out.		

Discuss the advantages and disadvantages of these different ways of responding, before continuing to answer the next questions.

BIG PICTURE: WHAT DO YOU DO WHEN YOU DON'T KNOW?

Imagine that you are a counselor at a summer camp on the ocean. You have swum there for many years. Then, one year, sharks are sighted shortly after the summer season. When you return the next summer, will you continue to swim?

Are you cautious or a risk-taker when your life might be involved?

Now, imagine that you are the swimming counselor at that camp, and you are responsible for others. Will you let them swim there? For example, if your little brother or sister were at the camp, would you allow them to swim?

Are you cautious or a risk-taker when other's lives might be involved?

Do you decide for yourself, or do you ask others to decide for you? Why? Why not?

Sharks are not toxic substances, but the situation is similar. We do not always know when a substance is harmful and when it is not. Once the substance is disposed of at our home, we do not know exactly where it goes. Will it be in the groundwater, a lake, Puget Sound, the soil in someone's garden - in a place where it might harm us? Given that we do not know whether many substances are harmful or not, what should we do:

1. About disposal practices for products?

2. About the manufacture and use of products?

Are your conclusions for yourself or for others, or is there not a difference? Discuss.

laws

HAZARDOUS REGULATIONS:

Congress has enacted several laws which regulate toxic substances, These laws control the manufacture, distribution, transportation, labeling, and workplace conditions involved in the creation and marketing of toxic or hazardous chemicals. In addition, they also regulate how much and where these chemicals can enter our rivers, lakes, and groundwater.

The worksheet UNRAVELING RED TAPE (p. 121) will help you become familiar with these laws and understand what they regulate and why.

EPA

RESOURCE CONSERVATION AND RECOVERY ACT (1976) (RCRA)

Protect public health and the environment by controlling the disposal of solid waste and regulating the management and handling of hazardous waste materials.

Purpose	Activities
-- Promotes the conservation of natural resources through the recovery of usable energy and materials	Lists criteria to identify hazardous wastes: ignitability, corrosivity, reactive, toxic.
--identify and monitor hazardous wastes from point of origin to their safe disposal. (called cradle to grave)	Exempts household hazardous wastes from RCRA regulations.
--regulate disposal of municipal and hazardous industrial waste.	Requires permits for facilities that treat, dispose, and store hazardous waste.
	Set standards for hazardous waste generators, transporters, and owners and operators of hazardous waste treatment, storage, and disposal facilities.
	Sets guidelines for states to set up hazardous waste management programs (new, not existing or abandoned.
	Provides procedures for inspection of facilities by EPA and state personnel
	Key is the manifest system: traces movement of waste from point generated to point of disposal.
	Authorises states to establish programs for closing and upgrading open dumps.
	Law not retroactive
	Provide mechanism for citizen suits against Act violators or violations.

EPA	CLEAN AIR ACT (1970, amended 1977) (CAA) Reduce air pollution and improve air quality

Purpose

--Establish air quality standards

--Maintain air quality in regions where air is already clean; there cannot be any "significant deterioration" of air quality in such regions.

-- Regulate contributions to pollution by factories, power plants, motor vehicle emissions.

Activities

Sets new source performance standards for new plant smokestacks for pollutants such as sulfur dioxide and particulates.

Design emission standards for specific air pollutants that are hazardous to health

Require registration of fuel and fuel additives

Only 5 designated hazardous air pollutants to date: asbestos, mercury, vinyl chloride, beryllium, benzene.

Washington State has motor vehicle emission standards and testing requirements.

CSPC	POISON PREVENTION PACKAGING ACT (1970) Make sure that products don't harm children by requiring child-proofing

--protect children from handling, using, or injesting hazardous substances.

Establish special packaging standards for hazardous household substances.

Establishes exemptions from standards for particular substances needed by the handicapped and the elderly.

DOT Mat. Tr. Bur.)	HAZARDOUS MATERIALS TRANSPORTATION ACT (1974) (HMTA) Make sure that hazardous materials are carried safely from one place to another: by road, rail, air

Purpose

--reduce number of transportation accidents

-minimize risk of catastrophic occurrences resulting from violation of hazardous materials regulations.

Activities

Define hazardous materials. 96 page list in fine print, Code of Federal Regulations

Can require special packaging, handling, placarding routing, or other actions necessary to ensure safe transportation of hazardous materials.

CSPC	FEDERAL HAZARDOUS SUBSTANCES ACT (1966) (FHSA) Describe hazardous substances and make sure they are labeled correctly

Purpose

--require that products containing a "hazardous substance" must bear a label of a specific size and contain certain information

--ban a hazardous household substance if required cautionary labeling would not be adequate to address hazard

Activities

Establish a definition for toxic, corrosive, irritant, flammable and radioactive substances.

Prohibit the interstate shipment of misbranded or inadequately labeled substances suitable or intended for household use.

Labeling includes: signal words; danger, warning, and caution; poison where specified. Description of principal hazards in use, list of common ingredients, instructions for safe handling, safe storage, first aid, name and location of manufacturer.

EPA

CLEAN WATER ACT (1972,-amended 1977) (CWA) Used to be Federal Water Pollution Control Act-1972

Wants to make sure that the streams and lakes of the U.S. are clean from toxic pollutants

Purpose

--restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

--publish water quality information and regulations.

--regulate spills of oil and hazardous substances on waters, including into storm drains that enter navigable waters.

Activities

Lists Priority Pollutants and establishes discharge limits for them. Presently lists over 120 substances

Sets strict limits on discharge of aldrin, DDT, toxaphene, endrin, PCBs and benzidine.

Requires that industrial waste going into public treatment plant be pretreated in order not to interfere with plant operation.

Requires application of best available technology to control discharges.

Sets forth conditions for inspection, monitoring and entry.

EPA

SAFE DRINKING WATER ACT (1974, amended 1977) (SWDA)

Protect the water we drink, and the wells and aquifers that supply it

Purpose

--provide definition for primary and secondary drinking water sources and protection for aquifers which are the sole or principal source of drinking water for an area.

--requires EPA to develop and apply national primary drinking water standards and regulations to ensure safe water in public water systems.

--prevent harmful contamination of groundwater sources by requiring regulations for State underground injection control programs.

Activities

Specify contaminants which may have any adverse effect on human health. Specify a maximum amount called a MCL or a treatment technique to reduce the level of contamination.

Gives EPA emergency power to protect public health as it relates to water systems.

Provides for research and studies regarding problems of drinking water supplies. Specifically calls for studies of viruses in drinking water and contamination by cancer-causing chemicals.

Authorizes private citizens to bring civil suit against any person alleged to be in violation of the Act.

Enforcement goes to the States.

CSPC

CONSUMER PRODUCT SAFETY ACT (1972) (CPSA)

Protect consumers against unsafe products

Purpose

--assist consumers in evaluating comparative safety of consumer products

--protect public against unresonable risks of injury associated with consumer products.

Activities

Develop safety standards for performance, composition, contents, design, construction, finish or packaging.

Set requirements for clear and adequate warnings to be marked on products.

Can ban products for which safety standards would not adequately protect the public.

EPA

FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (1948, 72, 75, 78) (FIFRA)

Control the use and manufacture of pesticides

Purpose

- --regulate the manufacture, use and disposal of "economic poisons." These include: any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating insects, rodents, fungi, weeds, and other forms of plant or animal life, including viruses (except in man and animals)
- --register all pesticides. A pesticide must be registered to be used.
- --review pesticides for possible de-registration. Called the RPAR process: Rebuttable Presumption against Registration. They have to evaluate the risks involved.
- --classify pesticides into general use (household) or restricted use (certified applicators)

Activities

Can regulate storage and disposal of pesticides.

Labeling requirements.

Special packaging requirements for pesticides that will be used in homes to make them somewhat childproof.

Can cancel or suspend use of a pesticide.

Exempts certain (small) amounts of pesticides from disposal recommendations.

All pesticides on the market at the enactment of FIFRA were given blanket ("grandfather") registration Review of these thousands of chemicals is a slow process.

Only about 30 substances have had registration cancelled or registered uses suspended.
RPAR decisions include: chlorobenzilate, edrin, 2,4,5,-T, silvex.

EPA

TOXIC SUBSTANCES CONTROL ACT (1976) (TSCA)

Tries to cope with the increasing problems of toxic substances and mixtures

Purpose

- --evaluates information abou all new chemicals before they are manufactured (other than food additives, drugs, pesticides, alcohol, and tobacco)
- --allows the EPA to regulate existing chemical hazards that are not sufficiently controlled under other laws.
- --defines imminently hazardous chemical substances or mixtures.
- --publish an inventory of chemical substances manufactured or processed in the U.S.

Activities

Collect data from industry on production, use, health and environmental effects of chemical substances and mixtures (excludes pesticides & drugs

Provide premarket clearance for new chemicals to prevent unreasonable risk to environment or health

Require reporting of significant new uses of existing chemicals.

Requires testing of certain chemicals to determine if there are any adverse health and environmental effects.

Prescribe standards to develop data required to assess chemicals under review.

Issue status reports on chemicals of interest.

Action to prohibit or limit manufacture, processing, use, disposal of a chemical. Can range from a ban to a labeling requirement.

Chemical substances or chemical mixtures banned or regulated under TSCA include: asbestos, polychlorinated biphenyls, chlorofluorocarbon in aerosol products.

Chemicals Substances Inventory lists 50,000 chemical sunstances manufactured or imported in U.S.

EPA	COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT (1980)

Called "Superfund," this act provides money to clean up spills and old hazardous dumps

Purpose

--$1.6 billion dollar fund for cleanup of spills of hazardous substances and for cleanup or inactive hazardous waste disposal sites.

--87.5% of fund is financed by tax on oil and specific chemicals. 12.5% is appropriated by Congress or EPA.

Activities

Can be used to clean up releases into the environment when no responsible party can be identified or when the responsible party is unwilling to clean up.

The government can sue to recover its expenditures.

FDA and EPA	FEDERAL FOOD, DRUG AND COSMETIC ACT (1938, numerous amendments) (FFDCA)

Make sure food is safe and produced under sanitary conditions

Purpose

-- directs FDA to ensure that foods are safe to eat, drugs are safe and effective, and that packaging and labeling of food and drugs are truthful and informative.

-- establish tolerance levels for pesticides in or on food.

-- establish tolerances for pesticides which are food additives.

--set tolerances for poisonous or deleterious substances which are required in the production of food or cannot be avoided in the manufacture of food.

--address the safety of food additives

Activities

Can prohibit manufacture, introduction, delivery, or receipt into interstate commerce of any food, drug, device or cosmetic that is adulterated or misbranded as well as the act of adulteration or misbranding.

Defines adulterated food: contains or has added to it a poisonous or deleterious substance which would cause it to be injurious to health.

"Delaney Clause" prohibits additions to food of any substance found to induce cancer in man or animals.

OSHA	OCCUPATIONAL SAFETY AND HEALTH ACT (1970) (OSHA)

Make sure people can work in a safe and healthful environment

Purpose

--insure that employers provide work conditions free from recognized hazards that are likely to cause death or serious physical harm.

--authorise Secretary of Labor to establish occupational safety and health standards.

--receives research from National Institute for Occupational Safety and Health (NIOSH)

--developing a standard to control occupational exposure to pesticides during manufacture and formulating

Activities

Standards of two types:
1) air contamination levels for exposure at work
2) limits for other types, includes regulations for warnings, protective clothing, signs, placards, and specified levels of exposure.

Requires employers to maintain accurate records of employee exposures to potentially toxic materials and guarantees employees access to these records.

Requires employers to notify employees of any exposure in excess of standards.

Provides for on-site inspection for enforcement.

WORKSHEET: Unraveling Red Tape Name____________________

Use the charts on the Federal Regulations (pages 118-120).

1. Write out the full title of the following abbreviations:

   a. FIFRA

   b. RCRA

   c. TSCA

2. Which laws have provisions for or specific requirements for labeling?

3. What kinds of labeling requirements are outlined as necessary to protect the public?

4. The Federal Hazardous Substances Act (FHSA) defines hazardous substances. What are they?

5. The Clean Water Act defines and discusses "priority pollutants." From the brief description given, what do you suppose they are? Why might they need to be monitored?

6. From these charts, which federal agency would you say has the largest share of the responsibility for toxic substances?

7. What does the expression "from cradle to grave" mean in relation to hazardous wastes?

8. If a transporter is carrying a piece of paper called a "manifest", what do you suppose he might be transporting? Why is it important for him to have this "manifest"?

9. FIFRA labels pesticides as "economic poisons". What do you think this expression means?

10. If you worked for a company that was responsible for transporting hazardous wastes to a hazardous waste site in Arlington, Oregon, which laws do you think you would need to be familiar with? Why?

11. What is a pesticide? Why do you suppose pesticides need to be regulated?

12. List five substances or mixtures that have been banned or severely regulated through the enactment of these laws.

Do you know anything about any of these? Explain.

13. Why do you suppose we need a law like the Safe Drinking Water Act to protect our drinking water?

14. Look up a definition for "aquifer". Why would aquifers need to be protected?

15. Where does your drinking water come from? How is your source of drinking water protected? Who controls it?

16. There is talk about using "Superfund" monies to clean up Commencement Bay in Tacoma. Do you know why this would need to be done?

Where else in this state might "Superfund" monies be used? and for what purpose?

17. What is the Delaney Clause? What does that mean to you? To the food you eat?

18. Proposals have been made to soften this regulation. The feeling of some folks is that it is too strict and that people should be allowed to make up their own minds. What do you think?

19. Why do you suppose a law like OSHA was developed? What do you know about this law?

20. TSCA tries to deal with the problem of chemical substances and mixtures before they are marketed (called premarket evaluation). Why do you suppose this is important?

21. A professional organization of chemical producers feels that the labeling requirements are too strict. They feel that too much information is confusing to the public and that more accidents would occur from consumers not reading all the information on the label. How would you feel about this? What kinds of products are required to have such labels?

section IV

SUPPLEMENTARY ACTIVITIES AND RESOURCES

This section includes a variety of exercises and ideas. The NURSERY RHYMES provide for interesting discussions at the elementary level--also adaptable for higher levels. The worksheet on READING LABELS could be used alone, or the students/teachers could set up a display table with a number of products, and use this worksheet on each of them. The HOUSEHOLD INVENTORY activity can be used either as an introduction or as a primary activity for younger grades. The more knowledgeable students will get the most out of the worksheet on NEW CHEMICAL SUBSTANCES and SUBSTANTIAL RISK, as these are complex issues.

The two chemistry/physical science activities (EVAPORATION and SOLUBILITY) may be used in conjunction with the Master Sleuth, or used alone. The PRODUCT TABLES are primarily meant as resources for the Master Sleuth.

EXTENDED ACTIVITIES are listed as projects for an entire class or small groups. The list is by no means exhaustive. Students who have worked through several activities in this curriculum unit will be able, by now, to suggest possibilities of their own. It is important to remember that although people who work at agencies and organizations are usually helpful and responsive to requests for information and assistance, they are also very busy doing their job and may have little time to be inundated with phone calls and requests. A good strategy and approach would be to make sure that efforts to get information do not antagonise those "from whom the information cometh".

A TEACHER's KEY for the GAME:DISPOSAL is provided. GENERAL COMMENTS and DISPOSAL CARD INFORMATION provide information to be considered for the general types of waste and disposal problems which students will encounter playing the game. Specific NOTES are then provided for each card.

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NURSERY RHYMES

Read the following nursery rhymes critically to determine their meaning.

Wee Willie Chemical

Wee Willie Chemical
Runs through the drain,
A blessing that he cuts the grease
And keeps your mother sane.

And yet he runs right through the pipe
And all the way to the ocean,
Where mixed with other chemicals
He might cause much commotion!

Wee Willie Chemical
Needs us to decide
When he's needed in the drain and
When in the can he can hide.

So be careful how you turn him loose,
And when you throw him away,
For if Wee Willie's persistent,
He's in the water to stay!

While Wee Willie Chemical
May be happy in the ocean,
Of hat he'll do to fish and fowl,
We haven't much a notion!

1. People use inaccurate words when they are making rhymes. Why is "chemical" a sloppy word to use in this rhyme?

2. What is meant by the statement that Willie might 'cause a commotion'?

3. What is meant by the word 'persistent'?

4. What is the benefit of this chemical?

5. What might be a disadvantage of this chemical?

6. How would you decide when to let him out of the can and when to leave him inside?

Mary, Mary

Mary, Mary, quite contrary,
How does your garden grow?
With Weed-and-Kills,
Your daffodils
Are the most beautiful I know.

Mary, Mary, quite contrary,
This Pestkill's mild and a treat,
No insects will crawl
Past your garden wall
To eat lettuce, parsnip and beet...

Mary, Mary, quite contrary!
Those insects are eaten by birds,
Who on ladybugs eat,
For whom aphids are meat
And will now swarm your garden
    in herds.

Mary, Mary, quite contrary,
Why don't you weed by hand?
Your Weed-and-Spill won't just
Daffodils kill
But insects throughout the land.

Mary, Mary, quite contrary,
If it's pests that you must
    slaughter,
To us confide
If that pesticide
Will contaminate the water!

1. Identify the places that exaggeration is used in this rhyme. Why is it used? State the bias presented each time an exaggeration is made.

2. What point is the rhyme trying to make when it says aphids might 'swarm the garden' after a pesticide is used?

3. How might a pesticide contaminate the water?

4. How does Mary benefit from using pesticides- chemicals that kill plants or animals?

NURSERY RHYMES

Little Jack Horner

Little Jack Horner
Sat in the corner,
Watching his father change oil.
He knew with some pain
If it went down the drain
The fish in the creek it would spoil.

Little Jack Horner
Sat in the corner,
He suggested the fireplace instead.
His father said no,
The oil's dangerous so,
It might combust into lead.

Little Jack Horner
Sat in the corner,
"The garbage instead we could use!"
Sharp as a beagle
His dad said "Not legal!"
"Our garbage service we could lose!"

Little Jack Horner
Sat in the corner,
Coundn't they bury it in dirt?
His father replied:
"Soil critters can't hide,
And many of them would be hurt."

Little Jack Horner
Ran out of the corner
Remembering his good friend Michael,
Who once had said
From his father's shed
Some substances they did recycle.

1. *How could the oil spoil fish?*
2. *Why would the father say the oil might combust into lead if they burned it in the fireplace?*
3. *Why would the father say that it is illegal to put oil in the trash?*
4. *Where do you think the father was going to put the oil?*
5. *What soil critters might Jack's father worry about?*
6. *What do you think Jack was going to do? What would he find out?*

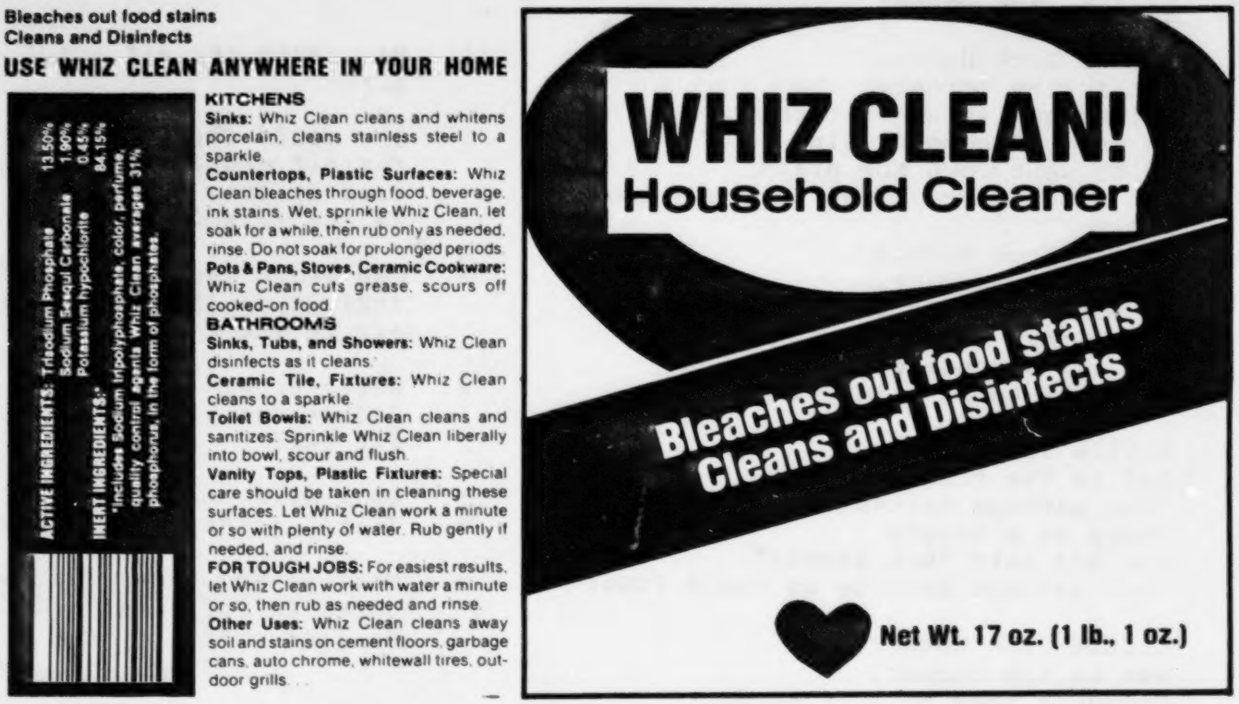
Jack Be Humble

Jack be humble, Jack be slow
To use a pesticide,you know.
For birds and beasts on whom we feast
Our eyes or even our bellies
They do not know those chemicals
To them are poisonous jellies.

And suddenly their song is gone,
And everything is quiet,
And beasts about now listen alone
To the world on a musical diet.

1. *What does the rhyme mean by a 'musical diet'?*
2. *Why would the rhyme say to Jack to 'be humble'?*
3. *On what birds do we feast our eyes?*
4. *On what birds do we feast our bellies?*
5. *How might pesticides hurt these birds?*

WORKSHEET: Reading Labels. . . .Household Cleaners Name________________



Bleaches out food stains
Cleans and Disinfects

USE WHIZ CLEAN ANYWHERE IN YOUR HOME

ACTIVE INGREDIENTS: Trisodium Phosphate 13.50%
Sodium Sesqui Carbonate 1.90%
Potassium hypochlorite 0.45%
INERT INGREDIENTS:* 84.15%
*Includes Sodium tripolyphosphate, color, perfume, quality control agents Whiz Clean averages 31% phosphorus, in the form of phosphates.

KITCHENS

Sinks: Whiz Clean cleans and whitens porcelain, cleans stainless steel to a sparkle.

Countertops, Plastic Surfaces: Whiz Clean bleaches through food, beverage, ink stains. Wet, sprinkle Whiz Clean, let soak for a while, then rub only as needed, rinse. Do not soak for prolonged periods.

Pots & Pans, Stoves, Ceramic Cookware: Whiz Clean cuts grease, scours off cooked-on food.

BATHROOMS

Sinks, Tubs, and Showers: Whiz Clean disinfects as it cleans.

Ceramic Tile, Fixtures: Whiz Clean cleans to a sparkle.

Toilet Bowls: Whiz Clean cleans and sanitizes. Sprinkle Whiz Clean liberally into bowl, scour and flush.

Vanity Tops, Plastic Fixtures: Special care should be taken in cleaning these surfaces. Let Whiz Clean work a minute or so with plenty of water. Rub gently if needed, and rinse.

FOR TOUGH JOBS: For easiest results, let Whiz Clean work with water a minute or so, then rub as needed and rinse.

Other Uses: Whiz Clean cleans away soil and stains on cement floors, garbage cans, auto chrome, whitewall tires, outdoor grills. . .

WHIZ CLEAN!
Household Cleaner

Bleaches out food stains
Cleans and Disinfects

Net Wt. 17 oz. (1 lb., 1 oz.)

1. What is the brand name of this product? ________________

2. What is this product used for? ________________

3. How does this product work? ________________

4. What are the active ingredients in this product?

________________ ________________
________________ ________________
________________ ________________
________________ ________________
________________ ________________

5. How should this product be used or applied? (List all pertinent directions)

____
____
____

6. Are there any application precautions given? ________________

____

7. MATH GEE-WHIZ! Each ingredient is usually indicated as a % of the total weight/volume of the product.

   a. What is the total weight/volume of the product?________________

   b. List the % of each ingredient in number 4.

   c. Compute the equivalent weight/volume of each ingredient listed.

8. How much is used per application?____

9. How long would it take to use up the entire box or bottle?_____________
(Number of applications?________
How much area would it cover? (if applicable)______________________

10. Are there any effects to human health or the environment which would result from use of this product?

11. What suggestions, if any, are given for disposal of the container?

12. Do you know of any alternatives to use instead of this product?

ACTIVITY: Household Inventory...What Do You Have in Your House?

Many people are unaware that many of the products they have in their homes are potentially toxic or hazardous. If you do this exercise as an introduction to the issue of household hazardous waste, you may be surprised at the number of products you find in each area of your house. If you do this exercise as an activity, after the SLEUTH for example, you may want to consider some of the use and disposal issues related to these products.

This activity is an Inventory. This means that you are going to poke around your house to find out what you have.

Caution: Do not disturb or spill any of these products. Some of them might be harmful. Wash your hands carefully after you handle any container that might be leaking. Ready?

1. You might want to team up with a friend and do this together. Go through the various parts of your house to INVENTORY the types of household products.

   Remember, not all household products are toxic.

   Check off those that you find. Add others that you find and were not on the list.

2. Note the quantities you find. For example, 12 cans of paint is a lot. You may want to do something about that. On the other hand, ½ pint of paint is not very much.

3. Rate how toxic or hazardous you think any of these products are. 1 would mean Practically Non-Toxic; 4 would be Very Toxic; 6 would be Super Toxic.

   Then ask your parents to rate these products.

4. Decide whether each product is likely to get used up or get thrown away.

5. Tally your results when you are finished.

When you all bring your results back to class, see what the class tally shows.

1. Did you or the class arrive at any conclusions from the information you collected?

2. What questions do you have about hazardous household products from doing this inventory?

   How would you or the class find answers to these questions?

INVENTORY

Name______________________

✓	Do You Have...?	How Much?	Your* Rating	Your parents' Rating	Will it Get Used?	Will it Get Thrown Away?
	Garage or Basement:					
_____	waste auto oil					
_____	gasoline					
_____	old antifreeze					
_____	used brake or transmission fluid					
_____	old batteries					
_____	cans of old paint					
_____	stains or preservatives					
_____	solvents, paint thinners, turpentine					
_____	paint strippers finish removers					
_____	rat poison					
_____	insecticides, kills bugs, ants, roaches, aphids, etc.					
_____	herbicides weed killers					
_____	slug bait					
_____	other garden pesticides: _______________ _______________ _______________					
_____	other: ___________					
_____	" ___________					
_____	" ___________					
	House					
_____	pet flea collars					
_____	flea sprays					

*1= practically non-toxic, 4= very toxic, 6= super-toxic.

INVENTORY, cont.

Do you have...? ✓	How much?	Your * Rating	Your parents' Rating	Will it Get Used?	Will it Get Thrown Away?
Kitchen/Bathroom					
_____drain cleaners					
_____abrasive cleaners					
_____household disinfectants					
_____other: _________					
_____ ____________					
_____ ____________					
Laundry Room					
_____detergent					
_____dry cleaning fluids, spot removers					
_____bleach					
_____other: _______					
_____ ____________					
_____ ____________					

	YOUR TALLY	CLASS TALLY
Most Quantity?		
Least Quantity?		
Your rating: Most toxic?		
Least toxic?		
Parents' rating: Most toxic?		
Least toxic?		
How much will get thrown away? (Estimate)	Where will it go?	Where will it go?

*1 = practically non-toxic, 4 = very toxic, 6 = super-toxic.

WORKSHEET: New Chemical Substances

Manufacturers must notify the EPA 90 days before they put a new product on the market. The following list is taken from the monthly "Chemicals in Progress" Bulletin put out by the Office of Pesticides and Toxic Substances.

NEW CHEMICAL SUBSTANCES FOR WHICH EPA HAS RECEIVED COMMENCEMENT OF MANUFACTURE NOTICES

(since publication of the December 1981 TSCA Bulletin)

PMN No.	Submitter	Chemical Identification G · Generic Name Do · Ditto	FR Citation
79-23	Uniroyal Chemical	G Ammonium salt of a polyfunctional aliphatic acid oligomer	44 FR 55416 9/26/79
79-11A	Claimed confidential business information CBI	Poly (vinyl acetate, acrylic acid, butyl acrylate, dioctyl maleate, 2-ethylhexyl acrylate)	44 FR 57489 10/5/79
80-18	Do	1-p-nitrobenzoyl-1(4′ carboxypyridyl) hydrazide	45 FR 13531 2/29/80
80-25	Do	G Bis (substituted-6,6,6-triacryloyloxymethyl-4-oxahexyl)dimethyl-disubstituted hetromonocycle	45 FR 16331 3/13/81
80-62	E I du Pont de Nemours Co	G Polyester resin aliphatic polyols, mixed aromatic di acids and aliphatic diacid	45 FR 24701 4/10/81
80-190	CBI	G Copolyester from dimethyl terephthalate, alpha, omega-hydroxy terminated aliphatic hydrocarbons and a polyalkylene glycol	45 FR 56429 8/25/80
80-306	Spencer Kellogg	G Urea/carbamate lacquer	45 FR 82708 12/16/80
80-318	Calgon Corp	Dimethyl diallyl ammonium chloride-acrylamide-potassium acrylate terpolymer	45 FR 83665 12/19/80
80-321	CBI	G Polymer of an alkyl acrylate, an alkyl methacrylate and saturated cyclic methacrylate	45 FR 82710 12/16/80
80-337	Abcor Inc	G Acrylamid-methacrylic copolymer	46 FR 2715 1/12/81
80-368	CBI	G Alkenylsuccinic acid, monoester	46 FR 12307 2/13/81
81-6	The Upjohn Co	Polyesteramide	46 FR 12836 2/18/81
81-7	CBI	G Modified resorcinol resin	46 FR 12314 2/13/81
81-10	Dow Corning	G Sodium salt of silylated phosphonate	46 FR 11352 2/6/81
81-30	CBI	G Polyester resin derived from a mixture of phthalic acids with alkylene glycols and higher polyols	46 FR 16118 3/11/81
81-95	Kelco	Polymer of d-glucose, succinic acid, propanoic acid, 2-oxo, and galactose, mixed ammonium, calcium, magnesium, potassium and sodium salt	46 FR 19314 3/30/81
81-103	Abcor Inc	G Alkylamine methacrylic copolymer	46 FR 27645 4/20/81
81-105	CBI	G Alkoxylated alkylphenl substituted sulfosuccinate, isopropylamine salt	46 FR 20767 4/7/81
81-112	American Hoechst	Butanamide, 2-[4(4-amino-carbonylphenyl]amino-carbonylphenyl]azo]N-(2,3-dihydro-2-oxo-1H-benzimidazole-5-yl)-3-oxo	46 FR 22645 4/20/81
81-132	CBI	G Maleic anhydride-based unsaturated polyester resin modified with mixed phthalic acids	46 FR 22648 4/20/81
81-141	Andrews Paper & Chemical Co	G N,N-diethylaminobenzene diazonium sulfonate salt	46 FR 23796 4/28/81
81-145	Do	G 4-N,N-dimethylaminobenzene diazonium sulfonate salt	Do
81-162	Diamond Shamrock	G Hydroxy-alkoxy alkyl alkane	46 FR 24990

Does this information help you?

What does CBI stand for?

How would you communicate with one of these companies if you were concerned about their product?

WORKSHEET: Substantial Risk.

The following article comes from a government bulletin published monthly called "Chemicals in Progress", from the EPA Office of Pesticides and Toxic Substances.

SUBSTANTIAL RISK...SECTION 8(e)

Under section 8(e) persons who obtain information which reasonably supports the conclusion that a substance presents substantial risk of injury to human health or the environment must notify EPA within 15 days. These notices are then reviewed by OTS and an initial evaluation is prepared containing, if appropriate, follow-up questions to the submitter, referrals to other agencies, and recommended OTS/EPA follow-up activities/actions. The 8(e) notices represent a company's first review of a situation and a judgment in compliance with the statute to submit a notice within 15 days of obtaining the information. EPA publishes its evaluations of these notices in order to make this section 8(e) information widely available and understandable to a broad public. The submissions and the initial evaluations are located in the OPTS Public Reading Room, first floor, East Tower, Waterside Mall, 401 M Street, SW, Washington, DC.

Persons wishing to obtain a copy of section 8(e) notices may write: Ms. Jerri Green, EPA (A-101), Washington, D.C. 20460. There is no charge for duplicating the first 49 pages, but at page 50 of a request for duplication there is a $10.00 fee and a 20¢ charge for each additional page (e.g., 51 pages cost $10.20).

RECENT SECTION 8(e) NOTICES OF SUBSTANTIAL RISK

Log No. 8EHQ		[CAS NO]
1281-0420	dibromochloromethyl propane (DBCMP)	
	*Report on DBCMP detected in Bromobutyl 2244, a brominated butyl rubber	
12781-0421S	p-tert-butyltoluene	98-51-1
	p-tert-butylbenzaldehyde	939-97-9
	*Report from a reproductive system toxicity study	
1281-0422	Unleaded gasoline	8006-61-9
	*Preliminary summary results, inhalation oncogenicity study	
1281-0423	Carbon fibers	
	*Summary report on chronic dermal oncogenicity study	
1281-0424	3,3',4,4'-Tetrachloroazobenzene	14047-09-7
	3,3',4,4'-Tetrachloroazoxybenzene	21232-47-3
	*Report from teratogenicity study (chick embryo)	
1281-0425S	Confidential chemicals	
	*Preliminary results from reproductive toxicity study	
1281-0426	N-[(4-oxiranylmethoxy) phenyl]-N-(oxiranylmethyl)-oxiranemethanamine	5026-74-4
	*Final reports on short-term mutagenicity screening studies	

S at the end of Log Number means a sanitized version is available.

N.B. All toxicity, oncogenicity, teratogenicity and mutagenicity studies involve animals unless otherwise stated. Additional tests (e.g., bacterial cells) are noted or are included in the term "battery".

How soon must people notify the EPA if they find evidence that a substance poses a substantial risks to humans?

What does EPA do with this information?

What else might they do?

Which of these substances do you recognize as household products?

Oncogenic means that a substance causes tumors which can be benign or cancerous. What would you do about such studies?

ACTIVITY: What is Evaporation?

Students can work alone or in groups to discover what goes into the air and how. Toxic substances can get into our environment in a number of ways--one of these ways is through the air.

EXPERIMENT

YOU WILL NEED:

1. Some small dishes, sometimes called petri dishes, or saucers.
2. The following ingredients:
   cooking oil
   water
   nail polish remover

FIRST:

1. Either in groups or as a class, define the word 'evaporation'.
2. Write it on the board and list the various definitions or suggestions of your classmates.

HYPOTHESIZE:

1. Which of the following do you think would evaporate most quickly?
   cooking oil
   water
   nail polish remover
2. How would increased temperature affect the evaporation? How would a lower temperature affect the evaporation?

TEST:

1. Pour small amounts of each of the three liquids into three small dishes. Label them carefully. It would help if the small dishes were glass and had sides so that you could easily measure any change in volume.
2. Make up a record sheet so that you can monitor the change. For example, you might want to check the amounts after an hour, then after 2 or three hours, and perhaps the next day.
3. After gathering your data on evaporation, draw your conclusions.
   a. which evaporated the most quickly?
   b. can you think of any reasons why it did? or why the others did not?
   c. where did the liquids that did evaporate go?
   d. were you aware of any of the liquids evaporating? could you smell any of them? How long did it take for the room to be filled with the odor of polish remover?
4. Under teacher supervision, heat the water. Does the process of evaporation increase, decrease, or remain the same? Do the same with the oil. What do you discover? Nail polish remover is very flammable and so it would be dangerous to heat. What do you suppose would happen if it was around heat?

FOLLOW-UP:

1. Evaporation is one method of dispersal. You have discovered that substances do not simply disappear but can be changed into a different form and are still with us.
2. Your last test worked with liquids. Now you can try solids, or powder or granules.
3. As a class or in groups, research the meaning of the word 'dispersal'. What does it mean?
4. Hypothesize what would happen to powders or granules if they were loose in the air.
5. Test your hypothesis by using dishes of powders of different sizes: talcum powder, baking powder, salt, flour, etc. Blow very gently on the dishes and compare your results.
6. Again, where did the substances go? Did weight or size affect their movement?

ACTIVITY: Solubility in Water

Toxic substances can find their way into the environment in several ways. One of these ways is by dispersing into the hydrosphere--water. We talk about whether a substance is soluble in water when we want to find out how it acts in the hydrosphere.

EXPERIMENT:

YOU WILL NEED:

1. Some glass beakers and stirring rods.
2. The following ingredients:
   flour
   salt or sugar
   nail polish remover
   cooking oil

FIRST:

1. Either in groups or as a class, define the word 'solubility'.
2. Write it on the board and list the various definitions or suggestions of your classmates.

HYPOTHESIZE:

1. Which of the following will dissolve in water?
2. What will happen to any that don't dissolve?

TEST:

1. Fill 4 beakers 3/4 full with cold water. Add 1 teaspoonful of each substance to the water and stir.
2. Record your immediate observations. Wait one hour and again record the results.
3. After gathering your data on solubility, draw your conclusions.
   a. which substances were soluble in water?
   b. what conclusions can you draw about the ones that did not dissolve? Were they heavier or lighter than water?
   c. what do you think happened to the nail polish remover?

FOLLOW-UP:

1. Solubility or insolubility is important when considering dispersal of substances in the environment. Consider what happens to soluble and insoluble substances in lakes, streams and the ocean.
2. Repeat the test using two insoluble solids with different particle sizes, such as flour and sand. What are the results after they have been left to settle? How can you explain these results?

3. Try the test again with 2,3,4,etc. teaspoons of sugar. Will it keep on dissolving?

4. Repeat the tests using salty water (like the ocean). Can you still dissolve as much sugar in the same amount of water? Do the insoluble substances behave any differently?

PRODUCTS TABLES: HOUSEHOLD "CLEANERS"

For more detailed information, see Metro's Household Hazardous Waste Disposal Project--Product Information Report.

Here is a list of the 16 most commonly used household "cleaners" according to a survey in a journal called PROGRESSIVE GROCER, 1979.

- Laundry soaps and detergents
- Toilet soap
- Scouring powder
- Furniture polish
- Dishwashing liquid
- Household cleaners
- Bleach
- Window cleaners
- Bathroom cleaners
- Toilet bowl cleaners
- Air fresheners
- Fabric softeners
- Oven cleaners
- Rug cleaners
- Laundry presoaks
- Drain cleaners

This table lists a few of the many substances found in household "cleaners". They are not necessarily the most toxic, but they are the most common.

SUBSTANCE	ENVIRONMENTAL FATE	BIOLOGICAL EFFECTS	DISPOSAL ISSUES
Phosphates including: trisodium phosphate (TSP) chlorinated TSP Sodium tripolyphosphate found in: detergents dishwashing liquids automatic dishwashing powder scouring powder all purpose cleaners window cleaners rug cleaners	Phosphates, which can be a serious environmental problem when sewage is discharged into fresh-water, does not adversely affect salt water systems, such as Puget Sound.	Phosphates can be an irritant to skin, eyes and respiratory tract. They are acutely toxic when ingested in large amounts.	Apart from solvents, where disposal issues are as described in the paint products table, the main disposal issue with household "cleaners" is one of use. Many of these substances are intended to go down the drain, and into the aquatic environment. They are so dilute by the time they get to the river or ocean that their environmental impact is negligible. THeir effectiveness often depends on their strength, however, and they are often very acutely toxic.
Sodium hydroxide Potassium hydroxide found in: powdered drain cleaners oven cleaners	Unless added to the environment in very large amounts, bases are readily diluted in water and become almost harmless.	These strong bases are very caustic and have high acute toxicity.	

Sodium hypochlorite found in: bleach		Bleach is very corrosive to skin and mucous membranes. Bleach also produces very poisonous fumes when mixed with acids or ammonia.	
Organic solvents: including; toluene 1,1,1-trichloroethane	For general information of solvents see Paint Products table.		

PRODUCT TABLES: AUTOMOTIVE PRODUCTS

SUBSTANCE	ENVIRONMENTAL FATE	BIOLOGICAL EFFECTS	DISPOSAL ISSUES
MOTOR OIL Oil is a hydrocarbon. A variety of additives may be used, such as: heavy metals aromatic and haolgenated hydrocarbons, detergents, dyes, TCP (tricresyl phosphate) Used oil contains contaminants from engine wear and combustion, such as lead, cadmium and mercury.	Oil is degraded in about 2 months by micro-organisms. Insoluble in water. Floats in sheets on water surface. Cadmium and lead are very persistent. Cadmium bioconcentrates in marine organisms. Cadmium (and to some extent lead) can be taken up by plants and transported to leaves and fruit. Lead bioaccumulates in algae.	Oil is toxic to mammals when ingested, and possible through dermal exposure. Toxicity varies according to the types of additives and the geographical origin of the crude oil. Oil destroys the natural insulating properties of fur and feathers, causing oiled water fowl or fur-bearers to die of cold. TCP: Oral LD_{50}(rats) = 4680mg/kg. Toxic to aquatic organisms at 1-10ppm. Lead is acutely toxic to aquatic invertebrates. In mammals, lead may cause kidney damage and neurological disorders. It is a teratogen and suspected mutagen. Cadmium is acutely toxic to fish at concentrations as low as 1ppb. It is a dangerous cumulative poison for mammals.	Large volumes are disposed of. In WA. state, 4½ million gallons/year of used motor oil are not recycled. Dumping into any waterway or surface water is illegal (CWA) The major problem is with oil entering rivers, lakes or the oceans. Cans have the following statement on the label - "Don't pollute, conserve resources, return used oil to collection centers."
ANTIFREEZE Main ingredient: ethylene glycol Sometimes small amounts of: borates, phosphates, silicates, are added as rust inhibitors. Used antifreeze is contaminated with heavy metals.	Ethylene glycol is water soluble. It is quite quickly degraded by micro-organisms. See motor oil for heavy metals.	Ethylene glycol is sweet tasting and may attract pets. In humans, it is metabolized into oxalic acid and/or excreted unchanged in the urine. It can have chronic kidney effects. It is acutely toxic to mammals when ingested in large quantities (Min. lethal dose for dogs = 7000mg/kg; for cats LC_{50} for aquatic organisms	Usually not disposed of in large enough quantities to cause problems in the aquatic environment. Disposal in septic tank not recommended due to unknown potential for contamination of ground water. Use on fence posts as a preservative not recommended as it can dissolve other preservatives and cause them to leach into the soil.

AUTOMOTIVE PRODUCTS (CONT).

SUBSTANCE	ENVIRONMENTAL FATE	BIOLOGICAL EFFECTS	DISPOSAL ISSUES
BRAKE AND TRANSMISSION FLUIDS Propylene glycol Mineral oils Heavy metals Detergents	See motor oil for heavy metals.		Can be added to used oil for recycling.
GASOLINE Gas is a hydrocarbon. Additives include: tetraethyl lead, ethylene dichloride/dibromide, amines, alkylated phenols, detergents, dyes	Gasoline is highly volatile and flammable. For lead, see motor oil.	Gasoline often contains benzene, a known carcinogen, and also toluene and xylene (see solvents) Lead (see motor oil). Tetraethyl lead is extremely toxic to mammals. Oral LD_{50} (rats) = 17mg/kg. Ethylene dichloride and dibromide cause liver damage. Certain alkylated phenols cause burns and severe skin disorders.	The main problem with disposal of gasoline is its extreme flammability. Uncontaminated gasoline can be reused. Contaminated gasoline should be disposed of with great care.

PRODUCT TABLES: PAINT PRODUCTS

This section includes the following products:

Paints
Laquers
Varnishes
Stains
Thinners
Paint strippers
Wood Preservatives

Paints contain:

1) Resins - substances which produce a film,
2) Solvents - volatile liquids which allow the paint to be applied in liquid form, and then evaporate -- which is what is happening when the paint is drying,
3) Pigments and colors.

Thinners and Paint strippers are almost 100% solvents

Wood preservatives are officially pesticides, but they are included in this category as people don't usually think of them as pesticides.

SUBSTANCE	ENVIRONMENTAL FATE	BIOLOGICAL EFFECTS	DISPOSAL ISSUES
RESINS			
ACRYLIC RESIN This is a general name for polymers (a long chain of relatively simple molecules repeated over and over again) of acrylic acid, methacrylic acid and its esters, or acrylonitrile.		May lead to allergic responses from skin contact or inhalation.	GENERAL DISPOSAL ISSUES. As a rough estimate, household use of paint in the metropolitan Seattle area is 1½ gallons/person/year.
PIGMENTS AND COLORS These used to be based on heavy metals such as lead, cadmium, antimony, chromium and mercury. These are still in arts-and-crafts paints but household paints are now made with less toxic metals.		For the health effects of heavy metals, see motor oil.	Disposal poses several problems: liquids should not be put in the trash (and paint is a liquid); flammable substances should not be put down the sink; the vapor is toxic..... Flammability is also a major concern in relation to storage and disposal. Solvents are often contaminated with other substances - for example, paint after cleaning your brush.
titianium dioxide		Physiologically inert.	
iron compounds	No significant hazards		

PAINT PRODUCTS (CONT.)

SUBSTANCE	ENVIRONMENTAL FATE	BIOLOGICAL EFFECTS	DISPOSAL ISSUES
SOLVENTS		Main exposure from inhalation due to volatility. All solvents are toxic, though to varying degrees. All can cause - skin disease, irritation to eye, nose and throat, "narcotic effects" on central nervous system leading to fatigue, irritability, headache, sleepiness, dizziness, nausea etc. Many cause damage to internal organs, particularly liver and kidneys. Some solvents are carcinogens, and some may damage the reproductive system.	
Propylene Glycol Glycol ethers and esters	Water soluble. Relatively low volatility.	Generally low acute toxicity to mammals, except for dioxane, which causes lung, liver and kidney damage.	
Methanol	Soluble in water Volatile.	Like ethyl alcohol, but excreted and metabolised more slowly. In primates can cause blindness.	
Toluene	Highly water soluble Volatile Can re-enter hydrosphere in rain Subject to photochemical degradation. Residues found in fish caught in vicinity of petrochemical industries.	Routes of entry - inhalation, ingestion, less so from dermal exposure. Irritant to nose and throat. Possibly causes chronic liver and kidney damage. Toxic to Coho salmon.	
WOOD PRESERVATIVES			
Pentachlorophenol (PCP)	Slightly soluble in water, collects in soil and sediments. Variable persistence depending on soil type. (3 weeks - 5 yrs.) Degraded by microbial activity or photolysis. Bioaccumulates in fish and mollusks.	Routes of entry - respiratory, GI, and especially dermal contact. Interferes with cellular respiration. Extremely toxic to mammals. Toxic to plants. Toxic to some aquatic species and mollusks at less than 10ppb.	

PRODUCT TABLES: PESTICIDES

SUBSTANCE	ENVIRONMENTAL FATE	BIOLOGICAL EFFECTS	DISPOSAL ISSUES
ORGANOPHOSPHATES	Can be broken down by hydrolysis and micro-organisms. Persistence varies: 1-18 months. Solubility low - moderate. Volatility - moderate. Mobility - low. Do not bioaccumulate.	Routes of entry -- dermal, GI, respiratory. Very fat soluble - easily absorbed. Irreversibly affect transmission of nerve impulses. Metabolised in liver -- metabolites excreted. Toxic to beneficial insects. Acutely toxic to fish at low concentrations.	GENERAL DISPOSAL ISSUES RELEVANT TO ALL PESTICIDES.
*Common examples: 1. diazinon general garden insecticide.	Hydrolysis half-life 185 days.	Very toxic to mammals. Oral LD_{50}(rats) = 25-80mg/kg. Evidence of teratogenicity and mutagenicity according to some studies. Especially toxic to ducks and geese. Hazardous to bees if foraging at time of application or a few days afterwards. Toxic to fish: LC_{50} (bluegill) = 0.03ppm	According to a 1980 study, 68% of all households throw used pesticide containers in the refuse. 29% of all households throw unused pesticides in the refuse. 4% of all households pour unwanted pesticides down the sink or toilet. Yard and garden pesticides can enter the environment through use, via leaching into the soil, evaporation into the air and in run-off with rain-water into the storm sewers or waterways.
2. dichlorvos (DDVP) no-pest strips, house insects.		Extremely toxic to mammals. LD_{50}(rats) =25-80mg/kg. Evidence of teratogenicity, mutagenicity and carcinogenicity in some studies. Toxic to fish: LC_{50} (bluegill) = 0.07ppm. Hazardous to bees if foraging at time of application or a few days afterwards.	A 1972 study of suburban use in 3 U.S. cities estimated an application concentration of 5-10lbs active ingredient per acre. No specific information on use in the King County area. Pesticides that are persistent and/or that bioaccumulate are of special concern environmentally. Many pesticides have some evidence of chronic health effects, although data are often contradictory.

PESTICIDES (CONT).

SUBSTANCE	ENVIRONMENTAL FATE	BIOLOGICAL EFFECTS	DISPOSAL ISSUES
CARBAMATES	Can be broken down by hydrolysis and microbial activity. Persistence varies: 1-18 months. Solubility moderate. Volatility - moderate. Mobility - low. Do not bioaccumulate.	Routes of entry -- GI, respiratory. Generally low dermal toxicity. Reversibly affect transmission of nerve impulses. Metabolized in liver and kidney, metabolites excreted. Toxic to beneficial insects. Toxic to fish.	
*Common examples:			
1. carbaryl (Sevin ®) garden insecticide		Moderately toxic to mammals: LD_{50} (rats) = 400-500mg/kg. Evidence of teratogenicity, mutagenicity and carcinogenicity in some studies. Human kidney is especially sensitive. Moderately toxic to fish: LC_{50} (trout) = 1-5ppm.	
2. propoxur (Baygon ®) roach killer	Long residual activity in soil.	Extremely toxic to mammals: LD_{50}(rats) = 95mg/kg Evidence of mutagenicity and carcinogenicity according to some studies. Highly toxic to birds feeding in treated areas. Toxic to fish: LC_{50} (fathead) = 0.025ppm.	
ORGANOCHLORINES	Not easily broken down, tend to be very persistent. Solubility very low. Volatility low - moderate. Mobility - low. Bioaccumulate and bioconcentrate.	Nerve poisons. Generally low acute toxicity to mammals. Stored in fatty tissues.	
*Common examples:			
1. DDT (dichlorodiphenyl trichloroethane) general insecticide, banned 1970.	Degradation products more toxic than parent compound.	Poor dermal absorption. Not highly toxic in mammals. Responsible for "thin eggshell" effect in some species of birds, causing serious population reductions.	

PESTICIDES (CONT.)

SUBSTANCE	ENVIRONMENTAL FATE	BIOLOGICAL EFFECTS	DISPOSAL ISSUES
2. lindane (gamma-BHC) general insecticide no longer available for general use. Active ingredient in Kwell shampoo for headlice.	Least persistent of organochlorines. Half-life = 1½years.	Readily absorbed dermally. Extremely toxic to mammals: LD_{50} (rats) = 76-90mg/kg. Teratogenic, mutagenic and carcinogenic after long term exposure. Chronic central nervous system effects. Toxic to fish: LC_{50} (rainbow trout) = 0.05ppm.	
CHLOROPHENOXY ACIDS			
*Common example			
1. 2,4-D (2,4-dichlorophenoxyacetic acid.) herbicide.	Degraded by oxidation and microbial activity. Persistence less than 3 months in damp soils, can be up to 18 months in dry soils. Solubility moderate. Volatility - high. Mobility - high.	Routes of entry dermal, GI and respiratory. Excreted relatively rapidly and unchanged. Causes some irritation of mucous membranes, and also neurological effects. Acutely toxic to mammals: LD_{50} (rats) = 400mg/kg. Relatively harmless to bees. Acutely toxic to fish at low concentrations. Controversial evidence of mutagenicity, teratogenicity and carcinogenicity.	

TYPICAL USAGES OF SOME ORGANIC PRIORITY POLLUTANT COMPOUNDS

(Ongerth and DeWalle, 1979.)

Compound	Major Usages
Methylchloride	Used as refrigerant, methylating agent.
Methylenechloride	Paint remover, solvent for insecticides.
Chloroform	May originate from drinking water as chlorination product.
1,1-dichloroethane	Produced during chlorination, produced in vinylchloride production.
1,1,1-trichloroethane	Widely used as industrial solvent, and household cleaners; produced in vinylchloride manufacture.
1,2-dichloroethylene	Impurity in 1,1-dichloroethylene.
Trichloroethylene	Degreasing solvent in metal industries; gradually phased out due to toxicity.
Tetrachloroethylene	Used by drycleaners and spot removers.
1,2-dichloropropane	Solvent in dry cleaning and degreasing processes; propane also present in gasoline; made as contaminant during trichloroethane production.
Benzene	Use greatly reduced through OSHA regulations.
Toluene	Component of gasoline; feedstock for benzene production.
Phenol	Used in glue and plywood manufacture.
1,2-dichlorobenzene	Coproduced during syntehsis of 1,4-dichlorobenzene.
1,4-dichlorobenzene	Solvent in household products (mothballs, bathroom disinfectants, deodorants).
Pentachlorophenol	Wood preservative and bactericide.
2,4-dimethylphenol	Used as petroleum solvent, carburetor cleaner.
Ethylbenzene	Antiknock compound in fuel; solvent for paraffin waxes; may represent up to 20% of common solvents as a replacement for xylene.
Isophorone	Solvent in finish products and lacquers.
Naphthalene	Coal tar and pyrolysis product; may be leached from tar.
Diethylphthalate	Component of PVC plastics to maintain flexibility.
Butylbenzylphthalate	Component of PVC plastics.
Di-n-butylphthalate	Component of PVC plastics; used in paint manufacturing.

TEACHER'S KEY FOR THE GAME "DISPOSAL"

(Game board, playing cards and game directions are on pp. 89-97.)

General Comments

The "playing cards" represent a number of possible household hazardous waste disposal problems and a few special solutions.

The following information is to guide teachers through the various possibilities for each "playing card". Some of this information is explained in more detail in other sections of the curriculum. The relevant pages have been noted.

Below are some general comments about types of household waste that appear several times in the cards. These are followed by special notes for each individual card.

General Comments	Page Reference
Pesticides A pesticide is a substance used to kill anything that is considered a pest - whether dandelions, slugs, insects, rats or roaches.	145,
Legal/Acceptable	
1. Use. Providing the pesticide is registered for general use (not banned or restricted), it may be used on the garden or lawn (whichever is appropriate), or shared with a neighbor for use in her garden.	
Students may want to discuss some of the advantages and disadvantages of using pesticides (getting rid of a nuisance vs. killing beneficial insects, entering water, or food chains, human health hazards).	48, 49, 52, 55, 62,
2. Storage or Garage.	
3. Disposal. Legally may go to a health department collection site or to Arlington, Oregon.	62,63,
Illegal/Questionable	
1. Garbage Can.	27,38
2. Burning. Good possibility of producing poisonous gases.	
3. Burial. (Variably questionable, depending on amount, concentration, persistence and toxicity.) May cause acute poisoning, or soil or water contamination.	
4. Storm drain. Direct contamination of waterways/lakes/ocean. Many pesticides are also very toxic to fish and other aquatic life.	33,45,

General Comments (continued)	Page Reference
Paints	
Paints contain solvents and pigments. Lead based pigments and some of the solvents in old paints are particularily toxic. Nowadays paints are made with less toxic ingredients.	143,
Legal/Acceptable	
1. Reusing is the best option. Either share with a neighbor, or paint the fence.	65,
2. Garage or Storage.	
Illegal/Questionable	
1. Burial, especially if lead pigment, or oil-based paint.	
2. Burning. Solvents are usually flammable - fire hazard. May produce toxic gases.	
3. Garbage Can. Illegal because it is a liquid.	27,38,
4. Storm Drain.	33,45,
Oil	
Motor oil contains a variety of additives. Used oil is also contaminated with heavy metals from the engine.	141,
Legal/Acceptable	
1. Recycling Center. Service stations may have facilities for collecting and reusing old motor oil.	61,
2. Storage or Garage. Doesn't really make much sense - it has no future use.	
Illegal/Questionable	
1. Storm Drain. Causes serious problems in aquatic environment.	33,45,
2. Burial. Potential for soil and groundwater contamination.	
3. Burn.	
4. Down the Sink.	29,32,39,
Antifreeze	
Ethylene glycol is the main ingredient. Used antifreeze will be contaminated from engine wear.	141,

General Comments (continued)

Page Reference

Legal/Acceptable

1. Down the Sink. Not recommended if you are on a septic tank. Degrades rapidly. Not usually thrown out in large enough quantities to cause problems in aquatic environment. 29,32,39,
2. Storage or Garage. Again, no future use.
3. Burial. This may be the best option if you live on a septic tank. But antifreeze is sweet tasting, and may attract and poison pets.

Illegal/Questionable

1. Garbage. It's a liquid. 27,38,
2. Storm Drain. This is too direct a route to our rivers and oceans. 33,45,

Solvents

Gasoline is a solvent and so are paint strippers, etc. Solvents are found in paints, and in a variety of household cleaners such as waxes and polishes, spot removers, drain openers and all-purpose cleaners. 141,143,

Legal/Acceptable

1. Recycling Center.
2. Arlington Hazardous Waste Facility.
3. Storage or Garage.
4. Share (if uncontaminated).

Illegal/Questionable

1. Storm Drain. 33,45,
2. Down the Sink. May be all right for some household cleaners, but not for products that contain mostly solvents. 29,32,39,
3. Burn. Solvents are usually very flammable. Fire hazard. Possibility of toxic fumes.
4. Burial. Potential contamination of groundwater.
5. Garbage. It's a liquid. 27,38,

TEACHER'S KEY FOR THE GAME "DISPOSAL"

DISPOSAL CARD INFORMATION

Arlington, Oregon: Washington does not yet have a hazardous waste dump. Land has been allocated for a dump at Hanford, but the legislature will have to approve funds to develop it. This has not been done. Until it is developed, hazardous wastes from Washington must be shipped to the one dump in Oregon. Commercial waste disposers collect batches of wastes until they have enough for a shipment to Oregon. Look in the Yellow Pages under "Waste Disposers" and phone to see if they'll take your waste. They will probably charge you. Household wastes are so small compared to industrial wastes that these firms do not really consider household wastes a market...but somewhat of a nuisance.

Recycling Center: There is no official recycling center for hazardous wastes. However, commercial waste disposal firms will take old oil, batteries and solvents, many of which they can treat in order to reuse them. Look in the Yellow Pages under "Waste Disposers". Many gas stations will take your old oil which they then deliver to a commercial disposer in large quantities.

Garbage Can: King County Solid Waste does not accept hazardous wastes and they do not accept liquids. Liquids will simply increase the leachate problem, already significant at some landfills. However, King County Solid Waste is supposed to take household wastes. While you may get away with tossing things in the garbage, you are contributing to increased health hazards for the region: leachate contaminating drinking water, entering food chains, affecting wildlife. (p.38, p. 102 #15-19)

Down the Sink: Anything that is poured down the sink goes either to a septic tank, or into a sewer system.

Septic tanks are explained in more detail on page 32. Basically anything that enters a septic tank will:

a. degrade
b. settle out in the sludge, or
c. drain out into the surrounding soil.

Metro's system is described in more detail on p. 30 and p. 39. Sewage goes to a treatment plant. Anything that enters the treatment plant:

a. degrades
b. settles out in the sludge, or
c. is released into Puget Sound.

Health Department: The Seattle-King County Public Health Department has a program for collecting household quantities of unwanted pesticides. They will take banned or restricted pesticides, or any other pesticide that you no longer want to use. There are six collection sites in and around Seattle. Householders must call the Health Dept. before bringing in an unwanted pesticide.

TEACHER'S KEY FOR THE GAME "DISPOSAL"

CARD NUMBER	NOTES
1	See general comments on antifreeze.
2	See general comments on antifreeze.
3	Legal/Acceptable 1. Storage. 2. Recycling Center. The liquid in a battery is strong acid. The battery casing is lead. Unadvisable to bury it because of the lead.
4	Self-explanatory.
5	Players may want to decide whether cards on the board can also be removed.
6	Self-explanatory.
7	The intention of this card is that you use the paint up and dispose of the empty cans in the garbage. Student puts cards in "disposal" pile.
8	Self-explanatory.
9	Note that students in some areas of the county have begun stenciling storm drains or posting signs to remind or advise people that they lead to streams. "Dump No Waste".
10	See card #9. Student may hold on to this card to use later. Things that you put in a stream might get into a fish or flow into Lake Washington, to one of your favorite beaches or to Puget Sound.
11	Student may use or hold in hand to play later.
12	See general comments on solvents.
13	What you have, basically, is pesticides. Consider them as such. Legal/Acceptable 1. Share with a neighbor who has a pet.

TEACHER's KEY FOR THE GAME "DISPOSAL"

CARD NUMBER	NOTES
14	Legal/Acceptable 1. Share. Might want to educate neighbor to alternatives. 2. Can Store in Garage. 3. Although commonly put in garbage can, technically disposal of liquids in landfills is illegal. Illegal/Questionable 1. Dangerous to burn aerosol cans.
15	See general comments on solvents.
16	Self-explanatory.
17	Floor waxes may contain solvents, acrylics, detergents or ammonia. Legal/Acceptable 1. Share with your neighbor. 2. Burial acceptable for small amounts if liquid. 3. Garbage Can, if not a liquid. 4. Down the Sink. Only for small quantities flushed with plenty of water. Illegal/Inadvisable 1. Storm Drain. Goes directly to aquatic environment. Solvents potential environmental hazard.
18	See general comments on paints.
19	See general comments on paints.
20	This is a solvent. It is contaminated with paint.
21	See general comments on paints.
22	" " "
23	" " "
24	" " "

TEACHER's KEY FOR THE GAME "DISPOSAL"

CARD NUMBER	NOTES
37	See general comments on pesticides.
38	" " "
39	" " " Obviously this poison cannot be used in the garden for insects.
40	The only acceptable options are the health department collection sites, or Arlington, Oregon. Store at your own risk! Banned pesticides have serious health or environmental hazards.
41	See general comments on pesticides. Slug bait may attract and poison pets. Burial may be an acceptable option for small amounts.
42	See general comments on pesticides.
43	" " " Use with extreme caution if pregnant.
44	See card #40.
45	See card #14.
46	Drain cleaners are mostly strong acid or alkali. Very acutely toxic but... Legal/Acceptable 1. Share with neighbor. 2. Storage or garage. 3. Down the Sink. The water in the sewer system will dilute the cleaner to the point where it is virtually harmless. Watch out for your pipes, though, if you have a lot of drain cleaner to get rid of. Illegal/Questionable 1. Storm Drain - too direct a route to waterways. 2. Garbage. Not allowed if liquid. 3. Burial. Not recommended due to high acute toxicity.

TEACHER's KEY FOR THE GAME "DISPOSAL"

CARD NUMBER	NOTES
25	See general comments on solvents (gasoline) and motor oil. This cannot be re-used.
26	See general comments on solvents.
27	" " "
28	What you have left is paint sludge and paint brushes in can. It probably would be acceptable to throw in the garbage.
29	See general comments on oil.
30	" " "
31	" " "
32	" " "
33	Fertilizers promote plant growth in streams, which uses up oxygen, which in turn kills fish and insects. Legal/Acceptable 1. Garbage Can. (You haven't totally avoided the problem of leachate.) 2. Share with a neighbor who lives away from the stream. Illegal/Questionable 1. Burial - if worried about leachate. 2. Storm Drains.
34	See general comments on pesticides.
35	" " " Diazinon is a garden insecticide. Depending on conditions, it may degrade in 3 weeks - 3 months.
36	Fish fertilizer is derived from dead fish. No human-made chemicals have been added. It will therefore decompose as a dead fish would.

TEACHER's KEY FOR THE GAME "DISPOSAL"

CARD NUMBER	NOTES
47	Carbon tetrachloride is a solvent that is no longer available to the public because of its serious acute and chronic health effects. The only acceptable options for disposal, therefore, are: 1. Recycling. 2. Arlington Hazardous Waste Facility.
48	TSP is trisodiumphosphate - a cleaning agent found in detergents and household cleaners. Legal/Acceptable 1. Share. 2. Garbage Can. 3. Garage or Storage. 4. Down the Sink. If you are on Metro's sewer lines, your sewage will go into Puget Sound, where excessive phosphates are not a problem. Don't put large quantities down the sink all at once if you are on a septic tank. People whose sewage goes to lakes or rivers should not use cleaners containing phosphates. Illegal/Questionable 1. Burial. Potential for contamination of ground-water. 2. Storm Drain. Enters waterways.
49	See card # 40
50	See card #14
51	See general anti-freeze comments.
52	See general comments on pesticides. Also see card #41.
53	See general comments on paints.
54	Self-explanatory.

TEACHER's KEY FOR THE GAME "DISPOSAL"

CARD NUMBER	NOTES
55	See general notes on pesticides.
56	This is possibly contaminated. See general comments on solvents. Also see card #25.
57	Players may also want to decide whether cards on the board (in storage, say) can also be removed.
58	If "Wonderclean" is a disinfectant it is considered a pesticide because it kills living creatures (bacteria). Treat as a low toxicity.

EXTENDED ACTIVITIES SUGGESTIONS

--Locate industrial areas in your community. What kinds of wastes do they generate? Where do they go?

--Locate information on storm drains, where they are and how they operate. Check several in your neighborhood or around your school to see if they are functioning as they should. Where does the water go after it enters the storm drain?

--Either in small groups or individually, survey local garden or hardware stores for toxic or hazardous substances that are carried on their shelves.

--Inventory the school's warehouse, custodial supply area, or cafeteria for potential hazardous substances. List items you find and determine appropriate methods for disposal of excess or waste amounts.

--Investigate how hazardous or toxic substances are treated at your school. Look in chemistry and biology labs, art studios, shop classes, photography labs.

*what toxic or hazardous substances are being used? Can you find benzene, carbon tetrachloride, or formaldehyde? What else?

*how are they being used? Are they necessary? Is personal protective gear being used?

*how are these substances being stored?

Look for:

- reactive chemicals stored together
- overstocking of chemicals
- safe storage areas - sturdy shelves, lockable, liquids below eye level, etc.
- toxic materials labelled and dated

*how are the hazardous or toxic materials being disposed of? Is there a system set up to handle discarded chemicals?

EXTENDED ACTIVITIES (continued)

--Arrange for a guest speaker to come talk with your class. A doctor could talk about toxicology, an ecologist about what happens in the environment, an agency official about how hazardous waste is controlled.

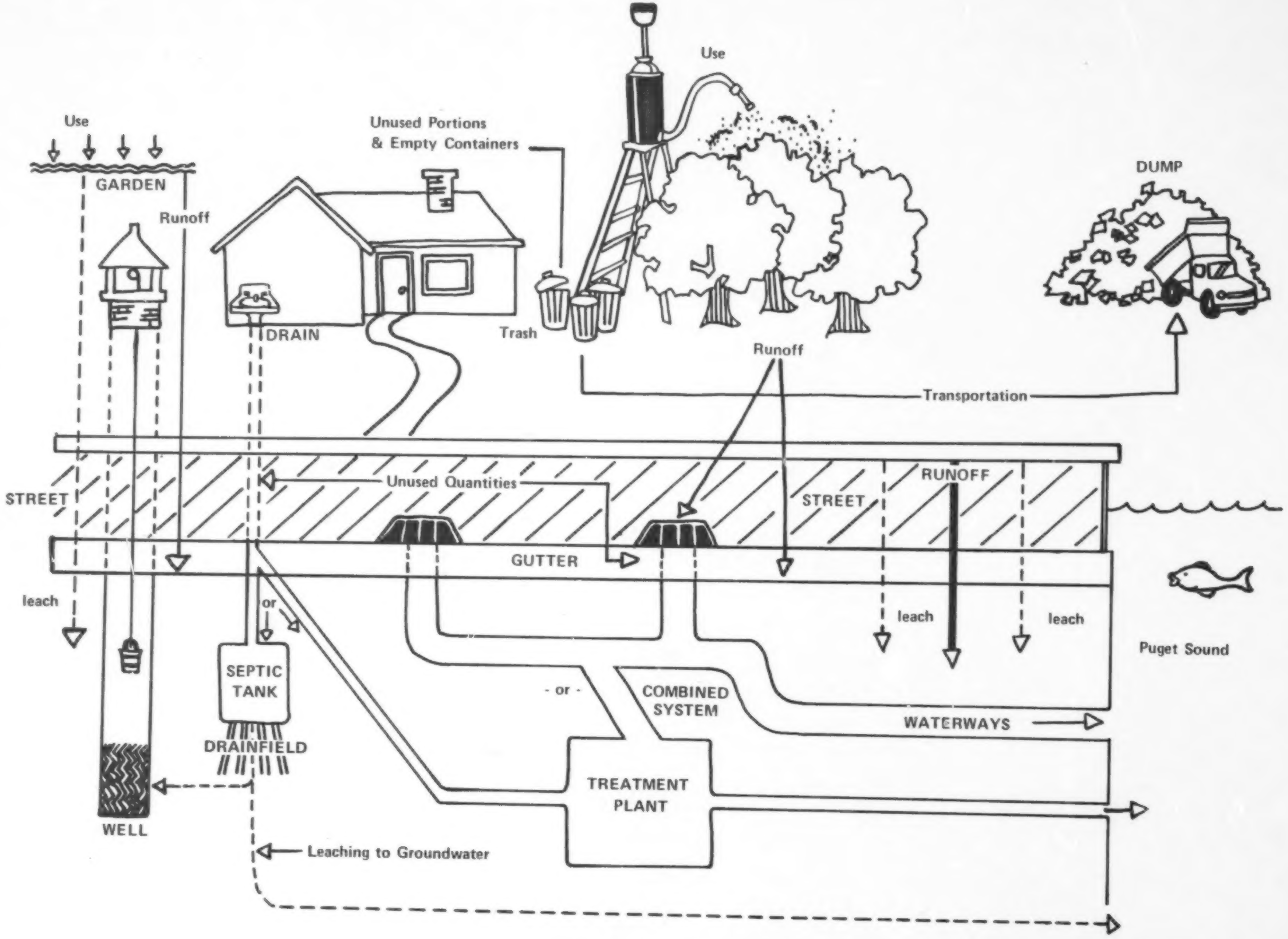
--Take a field trip to a Metro Sewage treatment plant, to a landfill, or to a chemical analysis laboratory. Call METRO (447-5885) for ideas and contacts.

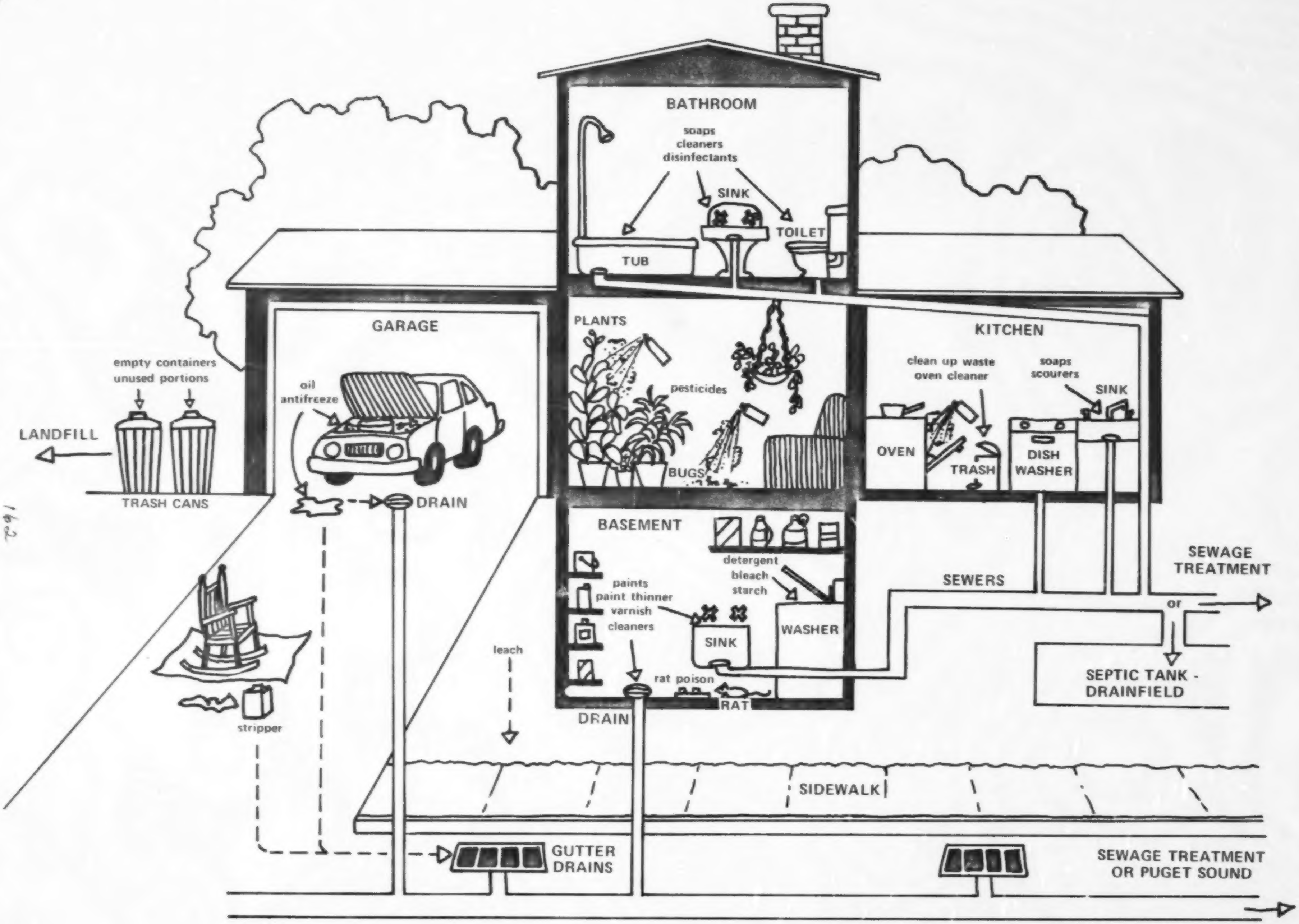
--Set up a hazardous waste information fair at your school. Build models of some of these processes. Distribute informational brochures at the fair--or in your community.

--Put on a futuristic play on hazardous waste. What will exist? What won't exist? Will some characters remember the "good old days"?

--Have a garage cleaning day (with your parents help!)

ROUTES TO THE ENVIRONMENT




BATHROOM
soaps
cleaners
disinfectants
SINK
TUB
TOILET
GARAGE
empty containers
unused portions
LANDFILL
TRASH CANS
oil
antifreeze
DRAIN
PLANTS
pesticides
BUGS
KITCHEN
clean up waste
oven cleaner
soaps
scourers
SINK
OVEN
TRASH
DISH WASHER
BASEMENT
detergent
bleach
starch
paints
paint thinner
varnish
cleaners
SINK
WASHER
rat poison
RAT
DRAIN
SEWERS
SEWAGE TREATMENT
or
SEPTIC TANK - DRAINFIELD
leach
stripper
SIDEWALK
GUTTER DRAINS
SEWAGE TREATMENT OR PUGET SOUND

EVIDENCE: HOW IS IT ABSORBED, DISTRIBUTED, ELIMINATED?